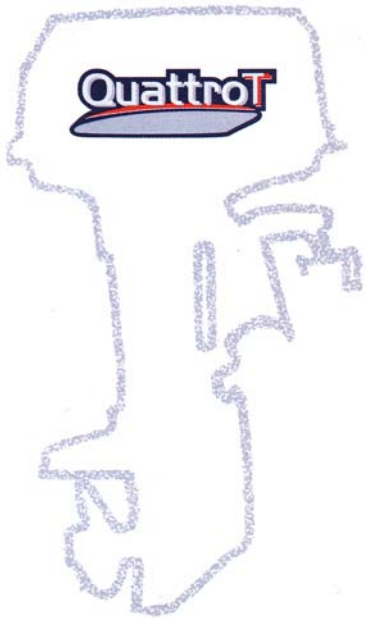
Killer Whale150 EFI

SERVICE MANUAL



SELVA Marine

NOTICE

This manual has been prepared by Selva primarily for use by Selva dealers and their trained mechanics when performing maintenance procedures and repairs to Selva equipment. It has been written to suit the needs of persons who have a basic understanding of the mechanical and electrical concepts and procedures inherent in the work, for without such knowledge attempted repairs or service to the equipment could render it unsafe or unfit for use.

Because Selva has a policy of continuously improving its products, models may differ in detail from the descriptions and illustrations given in this publication. Use only the latest edition of this manual. Authorized Selva dealers are notified periodically of modifications and significant changes in specifications and procedures, and these are incorporated in successive editions of this manual.

Important information

Particularly important information is distinguished in this manual by the following notations:

⚠ The Safety Alert Symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!

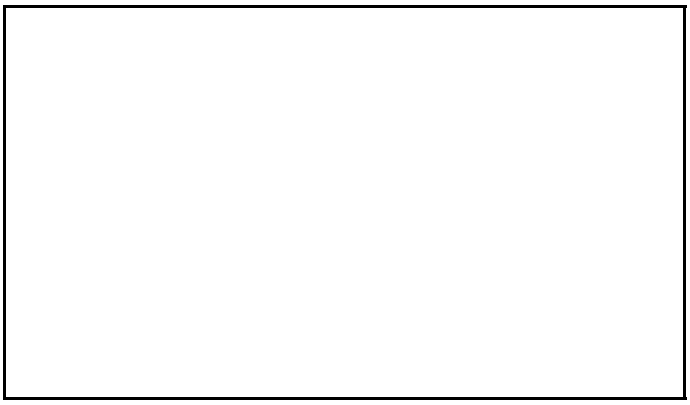
⚠ WARNING

Failure to follow WARNING instructions could result in severe injury or death to the machine operator, a bystander, or a person inspecting or repairing the outboard motor.

CAUTION:

A CAUTION indicates special precautions that must be taken to avoid damage to the outboard motor.

NOTE:



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How to use this manual

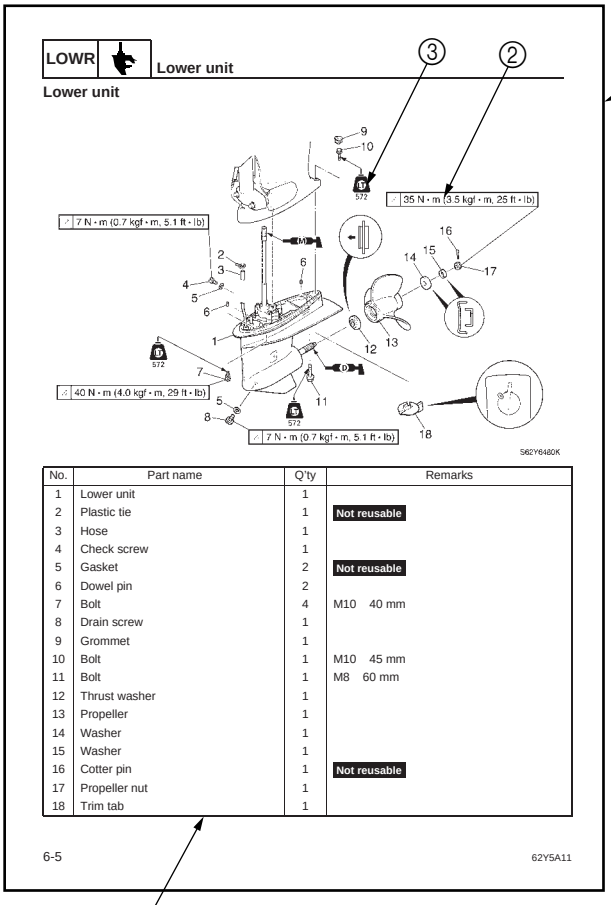
Manual format

The format of this manual has been designed to make service procedures clear and easy to understand. Use the information below as a guide for effective and quality service.

① Parts are shown and detailed in an exploded diagram and are listed in the components list.
② Tightening torque specifications are provided in the exploded diagrams and after a numbered step with tightening instructions.
③ Symbols are used to indicate important aspects of a procedure, such as the grade of lubricant and lubrication point.
④ The components list consists of part names and part quantities, as well as bolt and screw dimensions.
⑤ Service points regarding removal, checking, and installation are shown in individual illustrations to explain the relevant procedure.

NOTE:

For troubleshooting procedures, see Chapter 9, “Troubleshooting.”



LOWR Lower unit

Lower unit

No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Plastic tie	1	Not reusable
3	Hose	1	
4	Check screw	1	
5	Gasket	2	Not reusable
6	Dowel pin	2	
7	Bolt	4	M10 40 mm
8	Drain screw	1	
9	Grommet	1	
10	Bolt	1	M10 45 mm
11	Bolt	1	M8 60 mm
12	Thrust washer	1	
13	Propeller	1	
14	Washer	1	
15	Washer	1	
16	Cotter pin	1	Not reusable
17	Propeller nut	1	
18	Trim tab	1	

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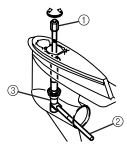
④

⑤

LOWR Lower unit

Removing the drive shaft

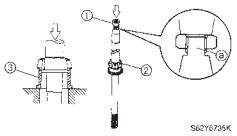
1. Remove the drive shaft assembly and pinion, and then pull out the forward gear.



Drive shaft holder 4 ①: 90890-06518
Pinion nut holder ②: 90890-06505
Socket adapter 2 ③: 90890-06507

Disassembling the drive shaft

1. Install the pinion nut ①, tighten it finger tight, and then remove the drive shaft bearing ② using a press.



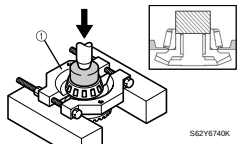
CAUTION:

- **Do not press the drive shaft threads ⓐ directly.**
- **Do not reuse the bearing, always replace it with a new one.**

Bearing inner race attachment ③: 90890-06639

Disassembling the forward gear

1. Remove the taper roller bearing from the forward gear using a press.

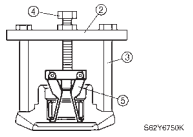


CAUTION:

Do not reuse the bearing, always replace it with a new one.

Bearing separator ①: 90890-06534

2. Remove the needle bearing from the forward gear.



CAUTION:

Do not reuse the bearing, always replace it with a new one.

Stopper guide plate ②: 90890-06501
Stopper guide stand ③: 90890-06538
Bearing puller ④: 90890-06535
Bearing puller claw 1 ⑤: 90890-06536

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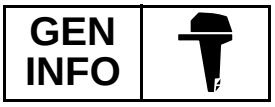
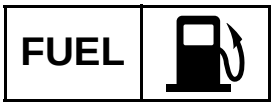
Symbols

The symbols below are designed to indicate the content of a chapter.

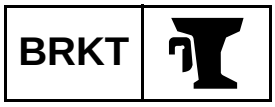
General information



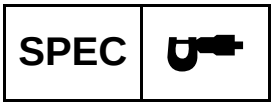
Fuel system



Bracket unit

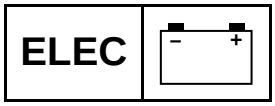


Specifications

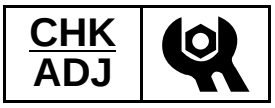


Power unit

Electrical systems

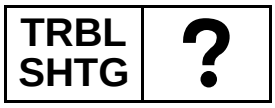


Periodic checks and adjustments

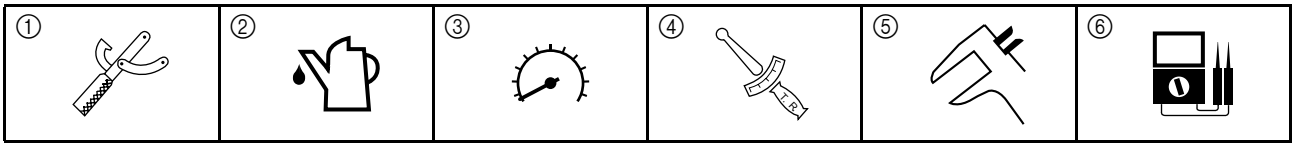


Lower unit

Troubleshooting

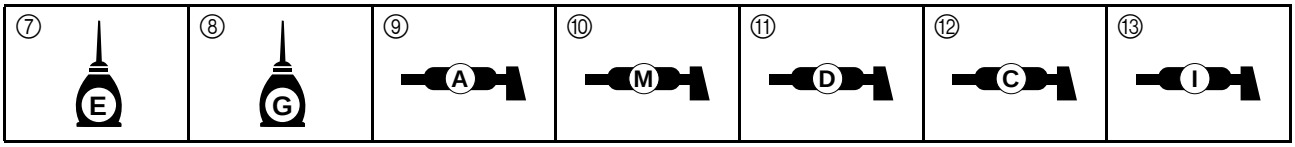


Symbols ① to ⑥ indicate specific data.



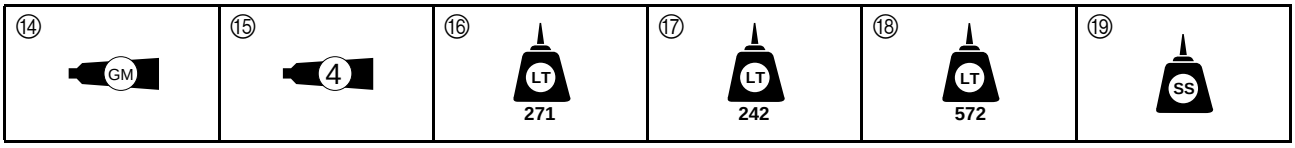
① Special tool
② Specified oil or fluid
③ Specified engine speed
④ Specified tightening torque
⑤ Specified measurement
⑥ Specified electrical value (resistance, voltage, electric current)

Symbols ⑦ to ⑬ in an exploded diagram indicate the grade of lubricant and the lubrication point.



⑦ Apply Selva 4-stroke motor oil
⑧ Apply gear oil
⑨ Apply water resistant grease
⑩ Apply molybdenum disulfide grease
⑪ Apply corrosion resistant grease
⑫ Apply low temperature resistant grease
⑬ Apply injector grease

Symbols ⑭ to ⑲ in an exploded diagram indicate the type of sealant or locking agent and the application point.



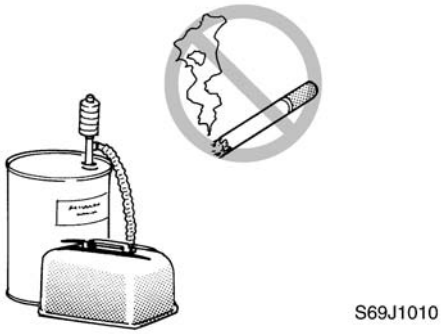
⑭ Apply Gasket Maker
⑮ Apply Yamabond No. 4
⑯ Apply LOCTITE 271 (red)
⑰ Apply LOCTITE 242 (blue)
⑱ Apply LOCTITE 572
⑲ Apply silicon sealant

Safety while working

To prevent an accident or injury and to ensure quality service, follow the safety procedures provided below.

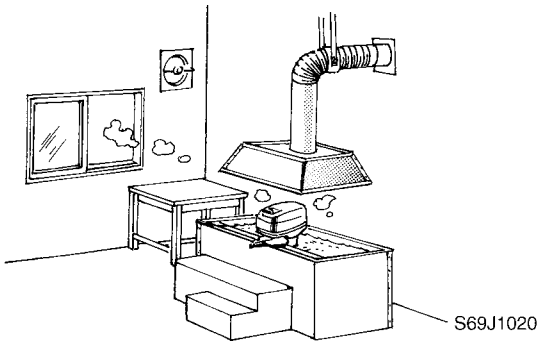
Fire prevention

Gasoline is highly flammable.
Keep gasoline and all flammable products away from heat, sparks, and open flames.


S69J1010

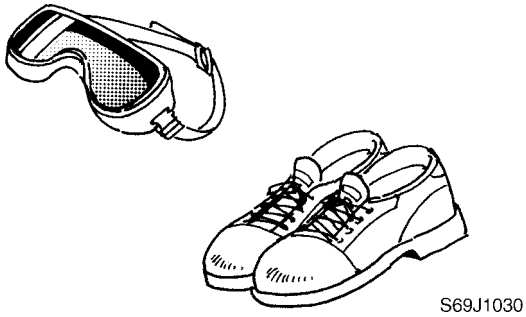
Ventilation

Gasoline vapor and exhaust gas are heavier than air and extremely poisonous. If inhaled in large quantities they may cause loss of consciousness and death within a short time. When test running an engine indoors (e.g., in a water tank) be sure to do so where adequate ventilation can be maintained.


S69J1020

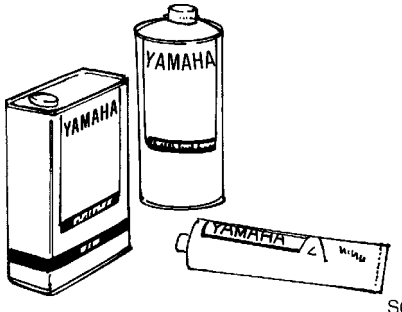
Self-protection

Protect your eyes by wearing safety glasses or safety goggles during all operations involving drilling and grinding, or when using an air compressor.
Protect your hands and feet by wearing protective gloves and safety shoes when necessary.


S69J1030

Parts, lubricants, and sealants

Use only genuine Selva parts, lubricants, and sealants or those recommended by Selva, when servicing or repairing the outboard motor.



S69J1040

Under normal conditions, the lubricants mentioned in this manual should not harm or be hazardous to your skin. However, you should follow these precautions to minimize any risk when working with lubricants.

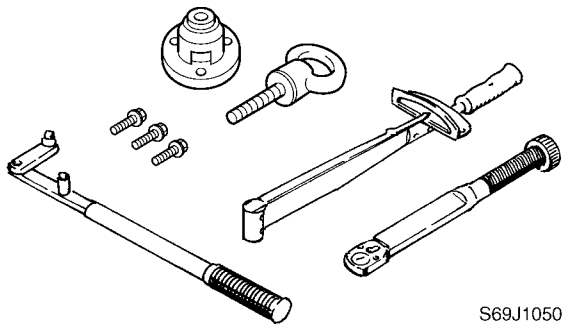
1. Maintain good standards of personal and industrial hygiene.
2. Change and wash clothing as soon as possible if soiled with lubricants.
3. Avoid contact with skin. Do not, for example, place a soiled rag in your pocket.
4. Wash hands and any other part of the body thoroughly with soap and hot water after contact with a lubricant or lubricant soiled clothing has been made.
5. To protect your skin, apply a protective cream to your hands before working on the outboard motor.

6. Keep a supply of clean, lint-free cloths for wiping up spills, etc.

Good working practices

Special service tools

Use the recommended special service tools to protect parts from damage. Use the right tool in the right manner—do not improvise.



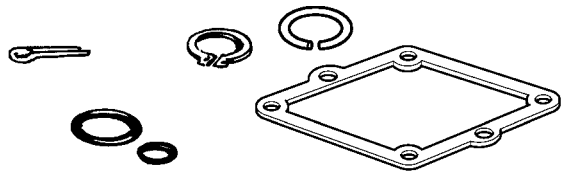
S69J1050

Tightening torques

Follow the tightening torque specifications provided throughout the manual. When tightening nuts, bolts, and screws, tighten the large sizes first, and tighten fasteners starting in the center and moving outward.

Non-reusable parts

Always use new gaskets, seals, O-rings, cotter pins, circlips, etc., when installing or assembling parts.

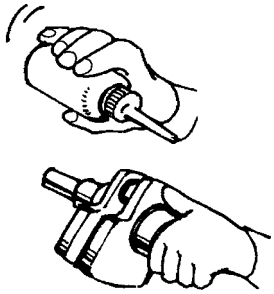


S69J1060

Disassembly and assembly

1. Use compressed air to remove dust and dirt during disassembly.

2. Apply engine oil to the contact surfaces of moving parts before assembly.



S69J1070

3. Install bearings with the manufacture identification mark in the direction indicated in the installation procedure. In addition, be sure to lubricate the bearings liberally.

4. Apply a thin coat of water-resistant grease to the lip and periphery of an oil seal before installation.

5. Check that moving parts operate normally after assembly.

Identification

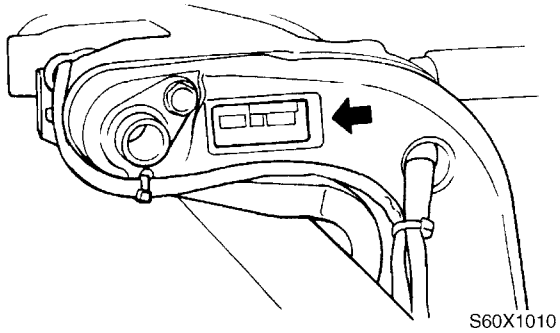
Applicable models

This manual covers the following models.

Applicable models
Killer Whale 150

Serial number

The outboard motor serial number is stamped on a label attached to the port clamp bracket.



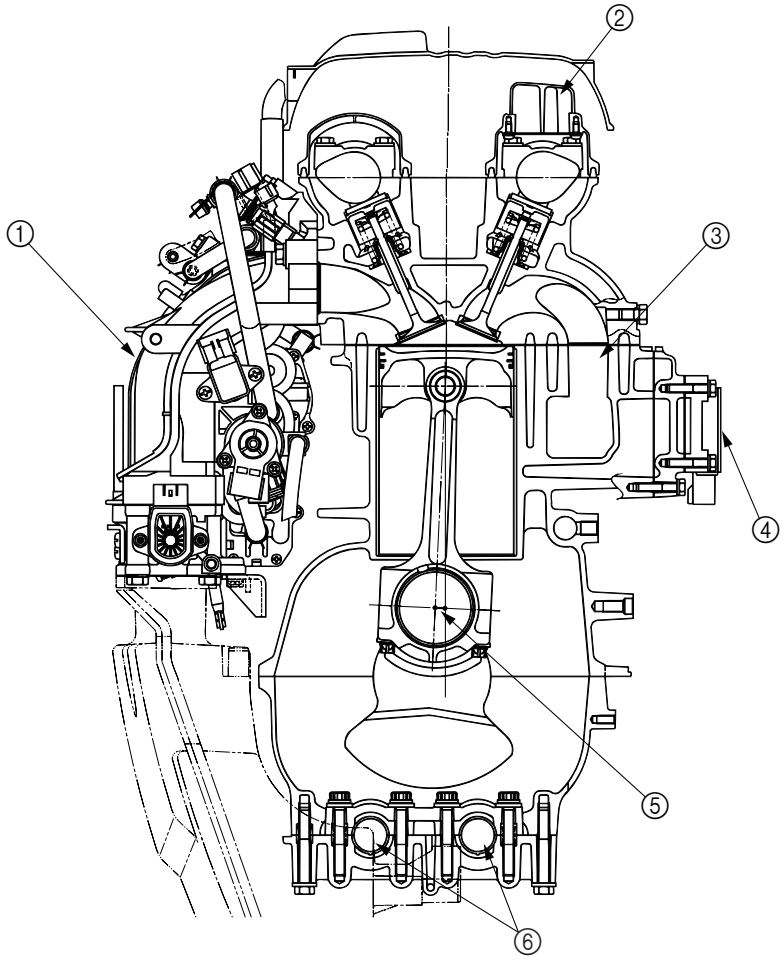
① Model name
② Approved model code
③ Transom height
④ Serial number

Model name	Approved model code	Starting serial No.
Killer Whale 150	63P	L: 1000017–
		X: 1000044–
Killer Whale 150 SX	64P	L: 1000013–
		X: 1000009–

Features and benefits

Crankshaft and cylinder

The center of the crankshaft is offset 10 mm (0.39 in) from the center of the cylinder to make more space to incorporate the throttle body assembly.
This design produces good engine balance and allows a compact design.
Exhaust gas from each cylinder flows directly into the exhaust manifold to obtain a compact design for the exhaust system.

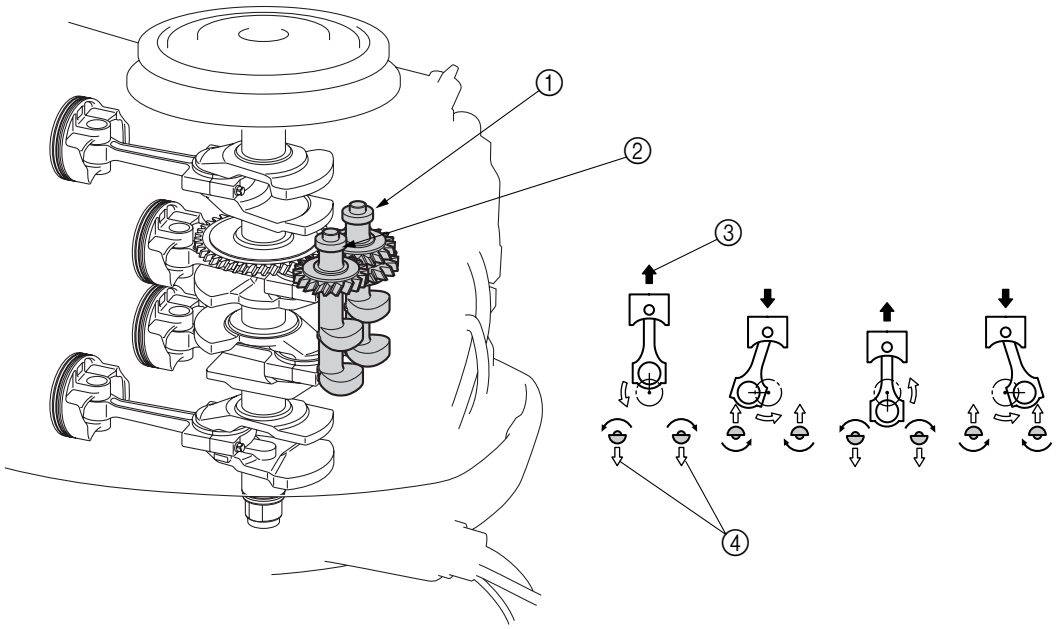


S63P1070

① Throttle body assembly
② Oil/gas separator
③ Direct exhaust system
④ Rectifier Regulator
⑤ Offset 10 mm (0.39 in)
⑥ Balancer shafts

Balancer

A two-piece balancer is used in the crankcase to reduce the secondary forces of inertia produced by reciprocating pistons.
The balancer shaft 1 is driven by the gear on the crankshaft.
The balancer shaft 2 is driven by the gear on the balancer shaft 1.
The two counterrotating balancer shafts rotate at twice the speed of the crankshaft and reduce the forces of inertia of the connecting rods and each balancer shaft.
Therefore, engine vibration is reduced.

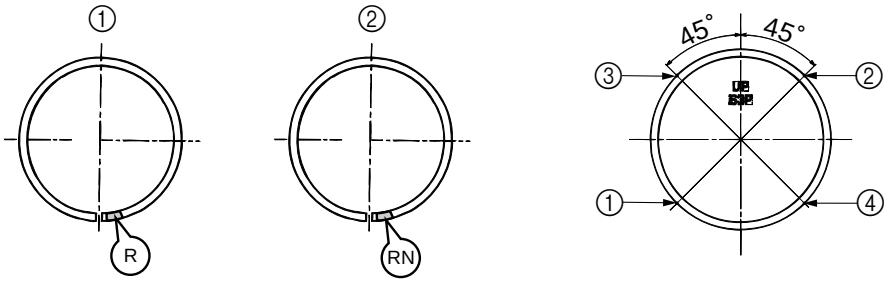


S63P1080

① Balancer shaft 1
② Balancer shaft 2
③ Piston secondary force of inertia
④ Balancer force of inertia

Piston and piston ring

A forged piston has been adopted for durability.
Hard chromium plating is applied to the piston rings.
The top and 2nd piston rings differ and are identified by a mark on each ring.
Install the piston rings on the piston with the identification marks facing up.

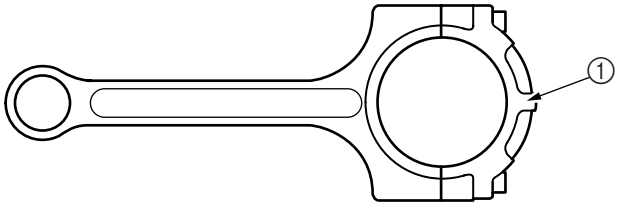


S63P1090

① Top ring
② 2nd ring
③ Upper oil ring rail
④ Lower oil ring rail

Connecting rod

A direction mark for installing the connecting rod to the crankshaft in the proper direction is on the connecting rod cap.
The direction mark should face the flywheel.
The connecting rod and connecting rod cap are manufactured as a single piece. Then, they are split using impact force. Only use the connecting rods and connecting rod caps in their original combinations, do not interchange them.

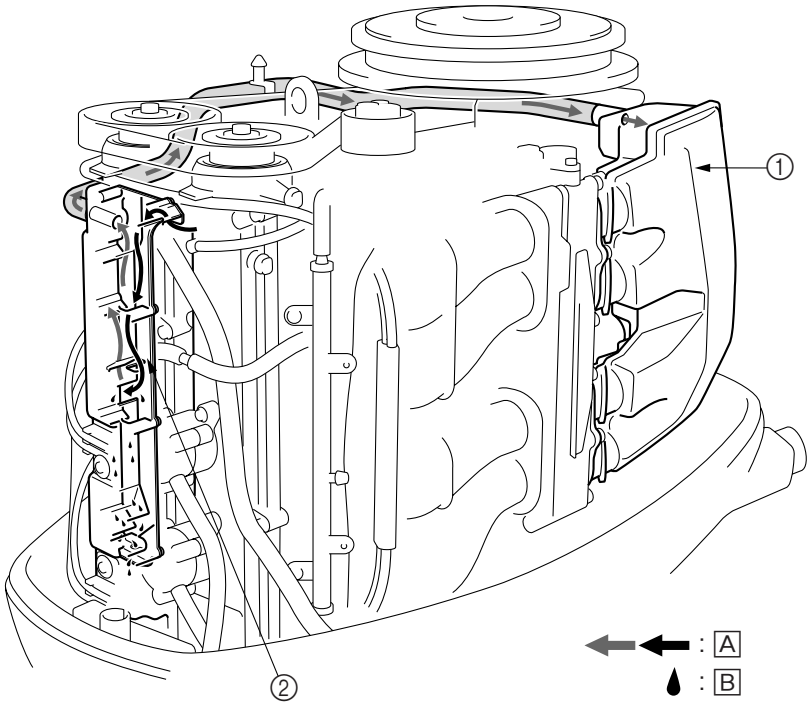


S63P1100

① Direction mark

Cylinder head cover

The oil/gas separator is used to obtain low emissions and is built into the cylinder head cover to obtain a compact design.
The gas and oil flow is shown below.



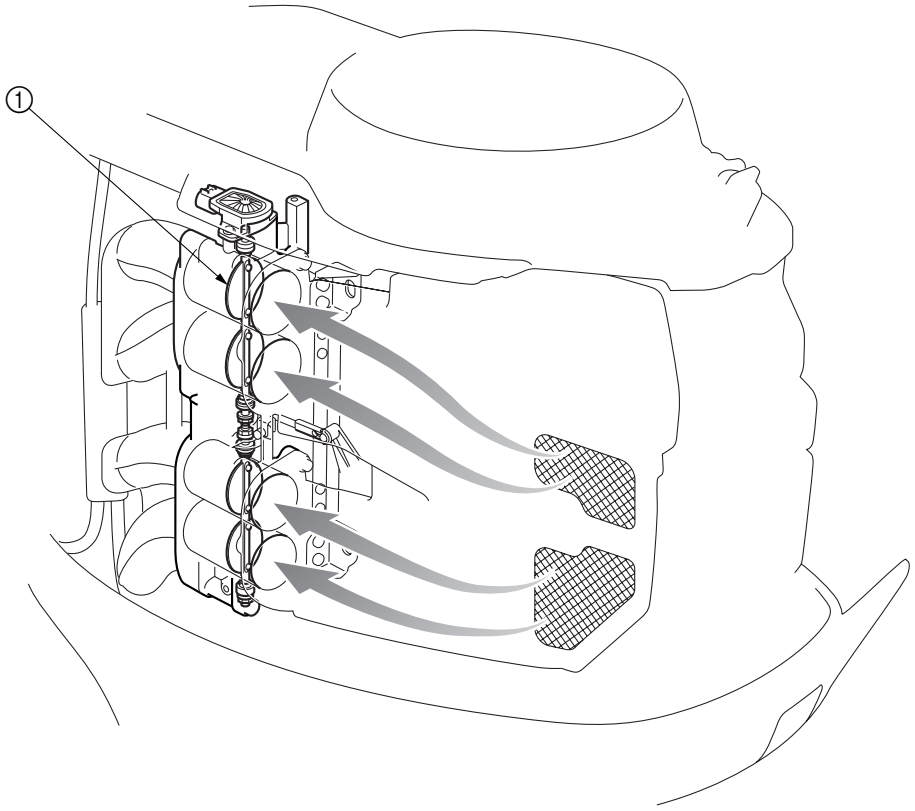
S63P1110

① Intake silencer
② Cylinder head cover (with gas/oil separator)

A Blowby gas
B Oil

Intake system

Multi-point, group fuel injection with four separate throttle valves is adopted for the intake system.
Intake air volume is calculated according to engine speed, Intake air pressure, and throttle position, and then the fuel injection volume is determined by the intake air volume to obtain a precise air and fuel ratio under all operating conditions.
The cylinders are grouped, #1/#4 and #2/#3. Fuel is injected twice during each full cycle of each cylinder, once during the exhaust stroke and once during the compression stroke. Fuel is injected during the compression stroke of the #1 cylinder and the exhaust stroke of the #4 cylinder and during the exhaust stroke of the #1 cylinder and the compression stroke of the #4 cylinder. The same occurs during the compression and exhaust strokes of the #2 and #3 cylinders.
This allows a simpler fuel injection control system.



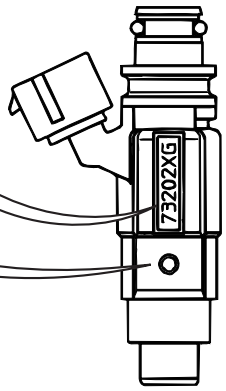
	Initial injection timing			
	BTDC10 ▼	▼	▼	▼
#1 cylinder	Compression	Combustion	Exhaust	Intake
#3 cylinder	Intake	Compression	Combustion	Exhaust
#4 cylinder	Exhaust	Intake	Compression	Combustion
#2 cylinder	Combustion	Exhaust	Intake	Compression

S63P1120

① Four separate throttle valve

The shape of the fuel injectors is the same for the F115, F150, F200 and F225.
Therefore, each fuel injector is identified by color because the specifications of each fuel injector are different.

A	B	C
F115	D	732
F150	E	731
F200 F225	F	741

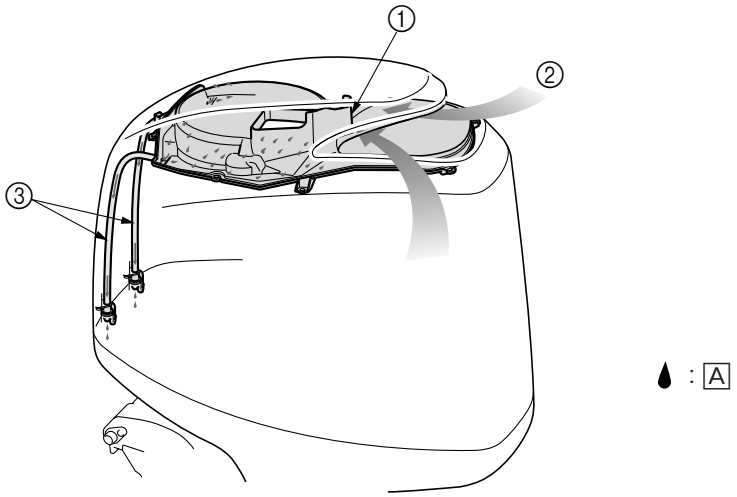


S63P1130

A Model
B Injector color
C First three digits
D Orange
E Yellow
F Ivory

Top cowling

Water is separated from the intake air and flows down through the drain hoses before draining out through the bottom cowling.
The structure of the top cowling helps to prevent water from accumulating in the top cowling and entering the power unit.



S63P1140

① Water separator
② Air (including water)
③ Drain hoses

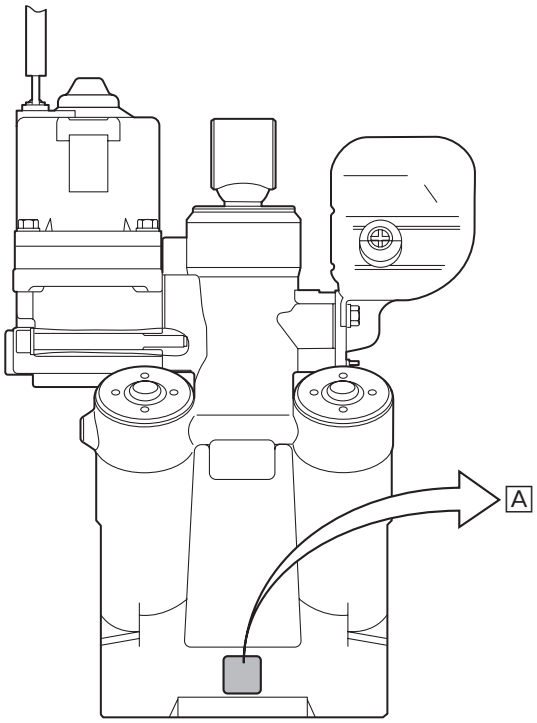
A Water

64E type power trim and tilt unit

The 64E type clamp bracket and power trim and tilt unit used for current V4 and V6 outboard motors have been adopted.

This allows easier interchanging of Selva outboards with the same classification because the mounting dimensions are the same.

For the power trim and tilt unit, only the impact absorber valve opening pressure of the tilt piston fluid circuit has been changed. The pressure is distinguished from those of other models by an identification mark stamped on the power trim and tilt unit.



S63P1150

A

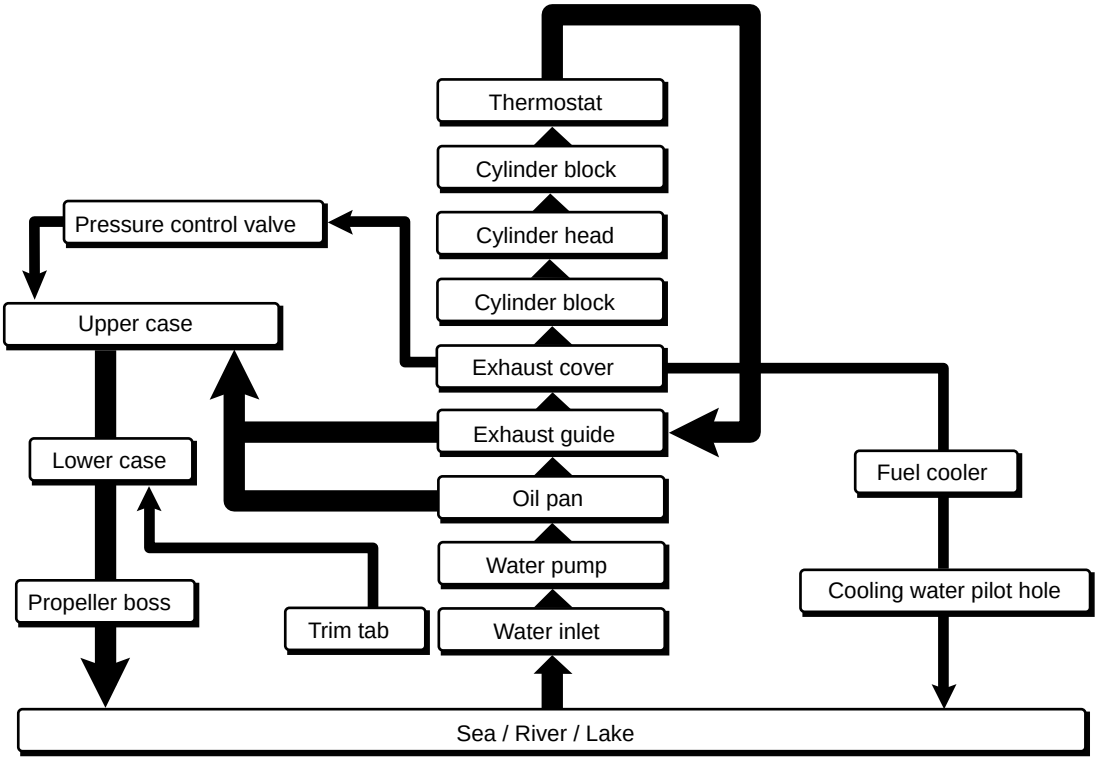
Identification mark	Applicable models
YA	Carbureted V4 and V6 (2.6)
YB	N/A
YC	Electronic fuel injected V6 (2.6), HPDI (2.6), VX200 (200H), VX225 (225G), and VX250 (250C)
YD	F115 (F115A), LF115 (FL115A), and (F100B)
YE	VZ225 (Z225H) and VZ250 (Z250F)
YF	F150 (F150A) and LF150 (FL150A)

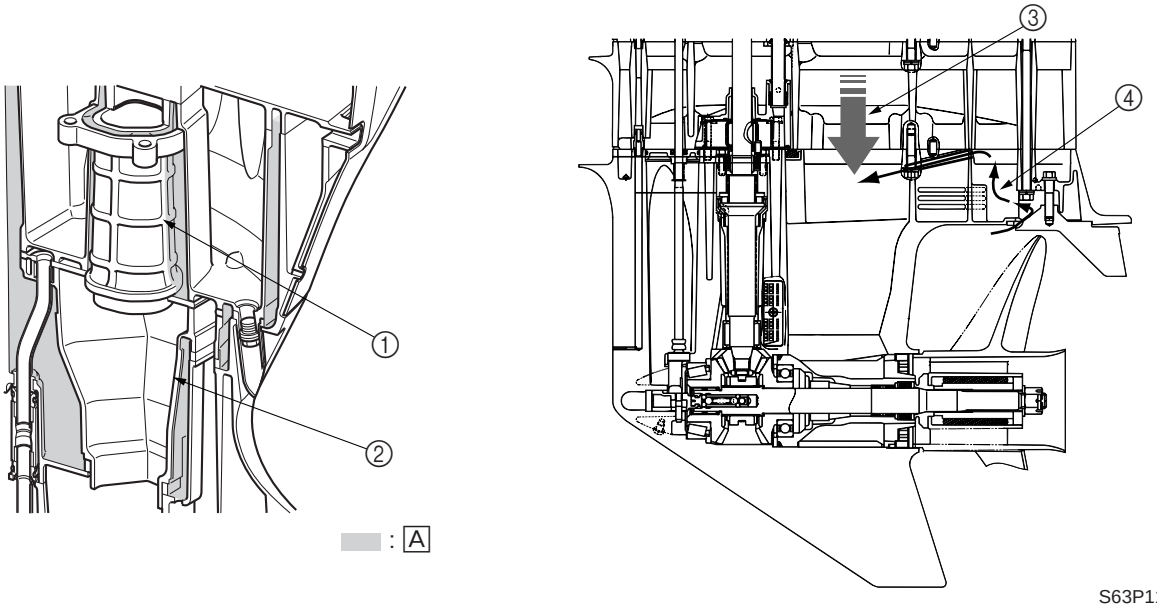
Cooling system

The cooling water flow diagram is as follows.

To cool the propeller damper, the cooling system is designed so that fresh cooling water is taken in from the front of the trim tab and supplied to the exhaust passage of the lower case to cool the exhaust gas.

Cooling water also accumulates around the exhaust muffler to cool the upper case and reduce exhaust noise.



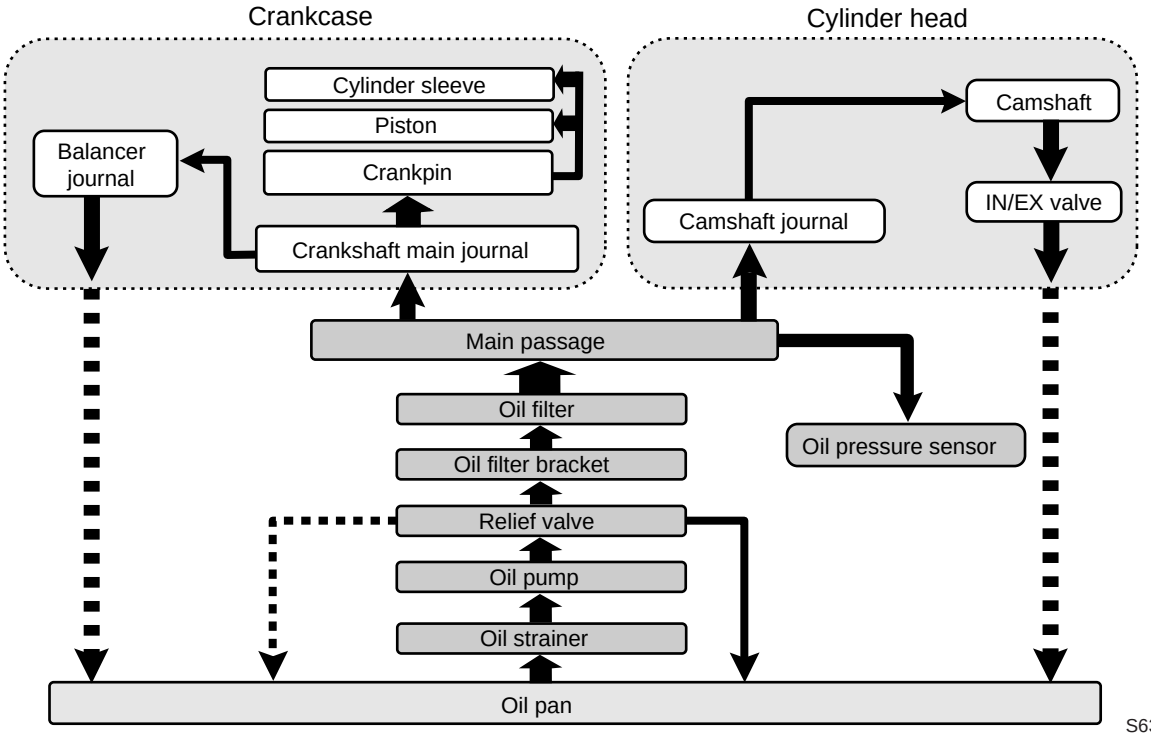


S63P1170

① Exhaust manifold
② Muffler
③ Exhaust gas
④ Water
A Water

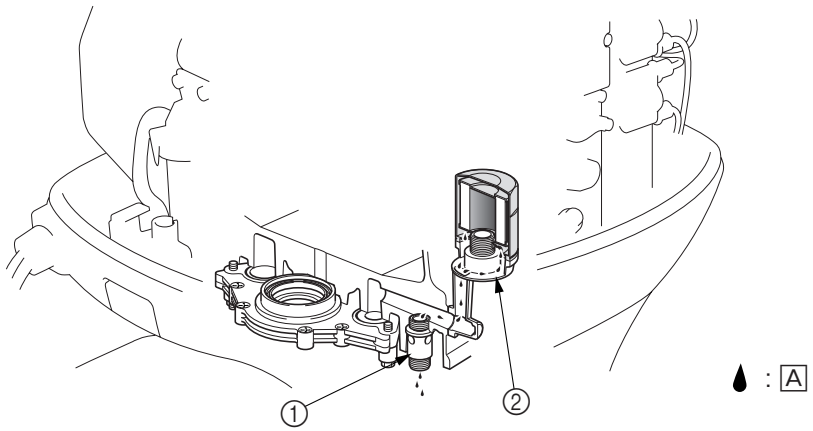
Lubrication system

The lubrication oil flow diagram is as follows.



S63P1260

There is a small hole in the relief valve to allow oil to drain from the oil filter bracket so that it does not remain in the oil filter. This prevents oil from spilling out when replacing the oil filter.

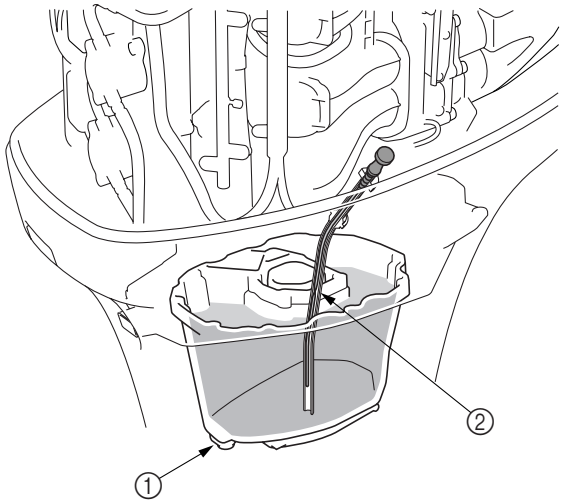


S63P1180

① Relief valve
② Oil filter bracket

A Oil

A dual oil drain system is adopted.
An oil drain bolt is located on the bottom of the oil pan.
A long dipstick guide, which reaches the bottom of the oil pan, can also be used to pump out the oil completely with an oil-extracting tool.

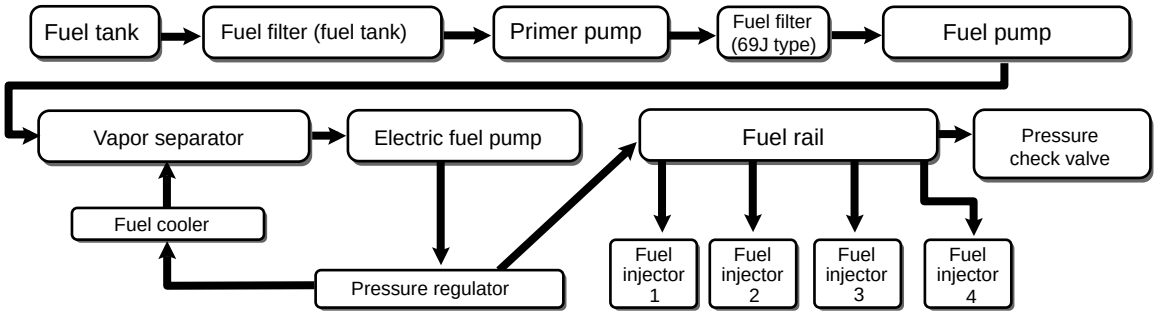


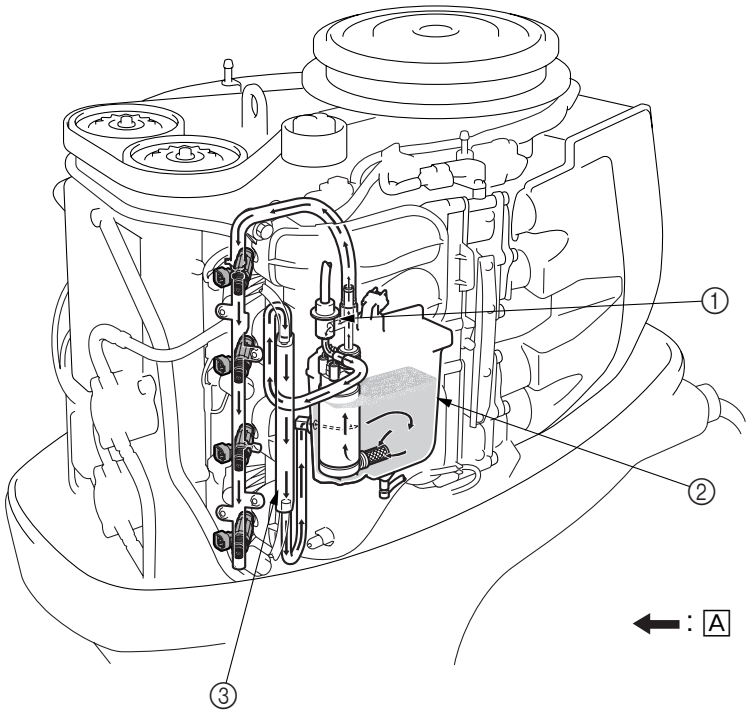
S63P1190

① Drain bolt
② Dipstick guide

Fuel system

A fuel pressure regulator is incorporated onto the outlet of the electric fuel pump to obtain a compact design and simple fuel delivery.
Fuel discharged from the pressure regulator returns to the vapor separator after being cooled in the fuel cooler.
The pressure check valve is incorporated onto the fuel rail for easier servicing of the fuel system.





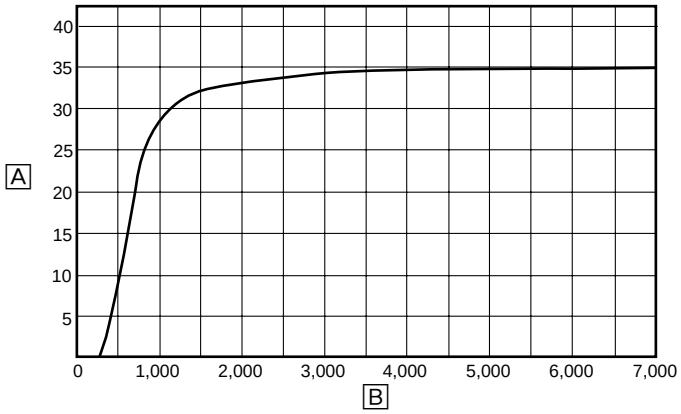
S63P1200

① Pressure regulator
② Vapor separator
③ Fuel cooler

A Fuel flow

Rectifier Regulator

A water-cooled Rectifier Regulator is incorporated onto the exhaust outer cover.
This allows for a compact engine design and produces a large electric current output for charging the battery under low engine speed.



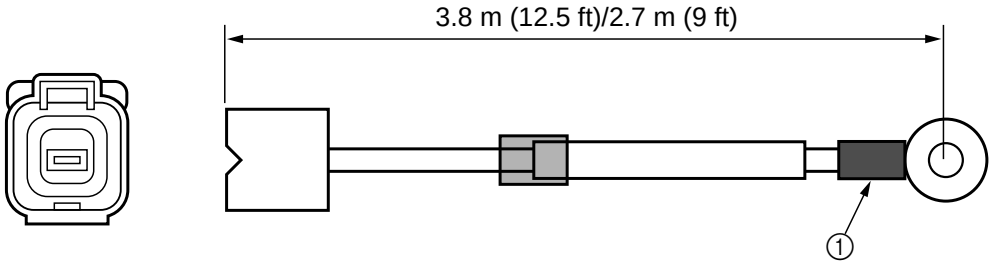
S63P1210

A Charging current (A)
B Engine speed (r/min)

Isolator

An isolator is incorporated into the Rectifier Regulator. If a second battery is used, connect an optional isolator lead.

Isolator lead P/N:	69J-81949-00 (3.8 m/12.5 ft)
	68F-81949-00 (2.7 m/9 ft)



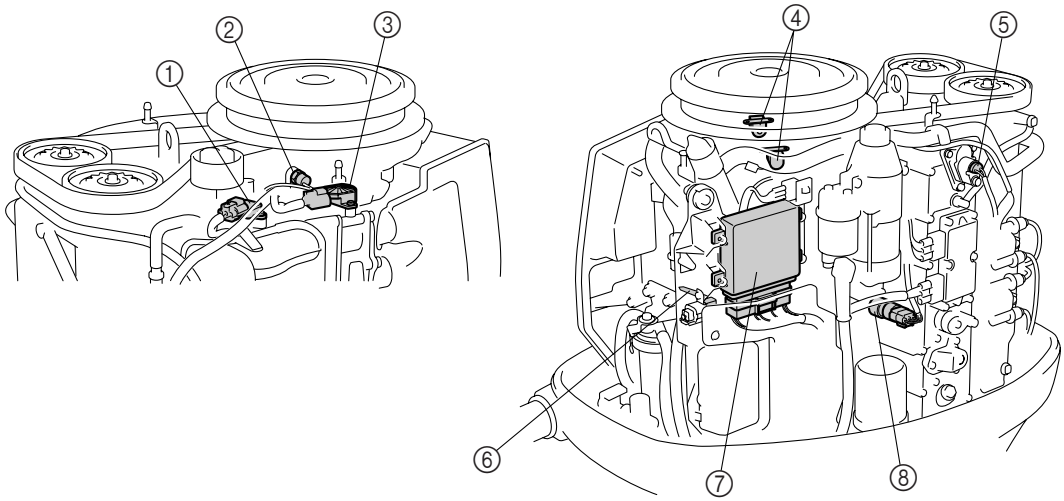
S63P1220

① Red tube

Technical tips

Electronic control system

The electronic control system consists of the sensors and the ECM (electronic control module). Under various conditions, the ECM provides the best suitable engine operation.



S63P1230

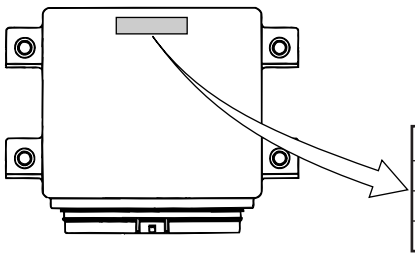
① Intake air pressure sensor
② Engine temperature sensor
③ Throttle position sensor
④ Pulser coil
⑤ Thermoswitch
⑥ Intake air temperature sensor
⑦ ECM
⑧ Oil pressure sensor

ECM

This engine is controlled by the ECM to obtain precise combustion under various operating conditions for high power output, low fuel consumption, and low emissions.

The ECM controls the ignition timing, the fuel injection timing, and the fuel injection volume and ensures that optimum ignition timing and an optimum air and fuel ratio can be achieved under all operating conditions such as starting the engine, normal operation, and quick acceleration.

The self-diagnostic function is incorporated into the ECM, and can quickly detect a malfunction when a personal computer is used with the optional software installed. (Refer to the " Diagnostic System Instruction Manual".)



A	B
63P-00	EUR
63P-10	USA, CAN, OCE
63P-20	JPN

S63P1240

A ECM identification
B Destination

Fail-safe control

If the electrical components malfunction, the ECM controls the ignition and fuel injection as shown in the table.

Malfunctioning item	Details	Ignition control	Fuel control
Pulser coil	No signal received during four consecutive crankshaft rotations	Fixed to BTDC 10°	Fixed to BTDC 10°
Throttle position sensor	Output voltage is 0.3 V or lower or 4.7 V or higher	Controlled according to the basic injection map	Controlled by Intake air pressure and engine speed
Intake air pressure sensor	Output voltage is 0.2 V or lower or 4.5 V or higher	Normal control	Fuel injection volume is controlled by the throttle position sensor
Engine temperature sensor	Output voltage is 0.18 V or lower or 4.93 V or higher	Normal control	Normal control
Intake air temperature sensor	Output voltage is 0.10 V or lower or 4.61 V or higher	Normal control	Normal control
Neutral switch	Switch is off when starting the outboard motor	Normal control	Normal control
Thermoswitch	The switch is on when the engine temperature is 40 °C (104 °F) or lower or the switch is off when the engine temperature is 130 °C (266 °F) or higher.	Normal control	Normal control
Shift cut switch	Output voltage is 4.50 V or higher, the switch is on when the outboard motor is started, or both the shift cut switch and neutral switch are on for 5 seconds	Normal control	Normal control
Oil pressure sensor	Output voltage is 0.3 V or lower or 4.8 V or higher	Normal control	Normal control

During fail-safe control, the engine idle speed increases to 900 r/min except if the neutral switch is off when the outboard motor is started.

Warning control

This outboard motor is equipped with warning control functions to avoid serious engine damage. The engine speed is limited to approximately 2,000 r/min if the engine overheats, if the oil pressure is low, or if a dual engine system (DES) is operated.
When a switch turns on, the engine speed is controlled as shown in the table.

Thermo-switch	Engine temperature sensor	Oil pressure sensor	DES signal	Engine speed	
				Less than 2,000 r/min	2,000 r/min or more
On	130 °C (266 °F) or higher (0.63 V or lower)	Below specified oil pressure due to engine speed	On	Fuel injection begins again in the cylinder order #3, #4, and #1	Fuel injection is shut off in the cylinder order #1, #4, and #3.
Overheat warning indicator lights and buzzer sounds		Oil pressure warning indicator lights and buzzer sounds	Buzzer sounds	**NOTE:** • The warning indicators light for 3 seconds after the engine start switch is turned on. • The buzzer sounds if the lanyard is removed from the engine stop lanyard switch while starting the outboard motor.	

Fuel injection is shut off in the cylinder order #1, #4, and #3 at 2.5-second intervals when the engine is running at 2,000 r/min or more.
Fuel injection to the #2 cylinder is not shut off.
When the throttle-opening angle is 30 degrees or less, fuel injection to the #3 cylinder will begin again.
When the engine speed decreases to less than 2,000 r/min, fuel injection will begin again in the cylinder order #3, #4, and #1 at 0.2-second intervals.
The warning control mode deactivates when the engine speed is less than 1,600 r/min or the throttle-opening angle is less than 7 degrees.

Shift cut control

This outboard motor is equipped with a shift cut control system for easier shifting.
This device misfires and retards the ignition of some cylinders to fluctuate the engine speed instantly when the engine is running from 400 to 2,000 r/min. This allows smooth engagement and/or disengagement of the dog clutch.
When shifting, the ignition is shut off as shown in the table.

Engine speed (r/min) / Shift cut switch	less than 400	400 to 729	730 to 2,000	2,001 or more
Off	N/A	N/A	N/A	N/A
On	N/A	Retards ignition timing	Misfires the #1 and #4 cylinders, and then retards ignition timing	N/A

N/A: No misfire control

Over-revolution control

This outboard motor is equipped with an over-revolution control system to protect the engine.
If the engine speed exceeds 6,200 r/min, the fuel injection is shut off as shown in the table below.

Engine speed (r/min)	Injected cylinder	Note
6,199 or less	#1, #2, #3, and #4	Normal operation
6,200 to 6,300	#2 and #3	Over-revolution control mode
6,301 to 6,550	#2	
6,551 or more	None	

Fuel pump control

The electric fuel pump operates for 3 seconds after the engine start switch is turned on and continues to operate while the engine is running.
The electric fuel pump stops 1 second after the engine is stopped.

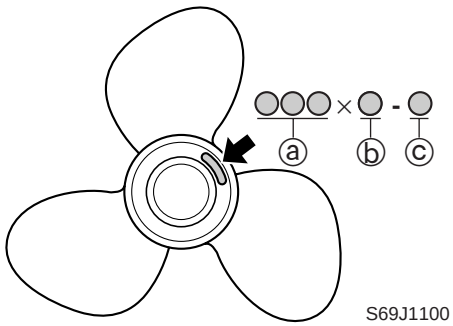
NOTE:
After the engine start switch is turned on, all of the fuel injectors are driven to prevent them from sticking before the electric fuel pump is driven.

Propeller selection

The performance of a boat and outboard motor will be critically affected by the size and type of propeller you choose. Propellers greatly affect boat speed, acceleration, engine life, fuel economy, and even boating and steering capabilities. An incorrect choice could adversely affect performance and could also seriously damage the engine.
Use the following information as a guide for selecting a propeller that meets the operating conditions of the boat and the outboard motor.

Propeller size

The size of the propeller is indicated on the propeller boss end.



ⓐ Propeller diameter (in inches)
ⓑ Propeller pitch (in inches)
ⓒ Propeller type (propeller mark)

Selection

When the engine speed is at the full throttle operating range (5,000–6,000 r/min), the ideal propeller for the boat is one that provides maximum performance in relation to boat speed and fuel consumption.

Regular rotation model

Propeller size (in)	Material
13 1/2 × 23 - M	Aluminum
13 3/4 × 21 - M	
14 × 19 - M	
14 1/2 × 17 - M	
15 1/4 × 15 - M	
13 3/8 × 23 - M	Stainless
13 3/8 × 25 - M	
13 3/4 × 17 - M2	
13 3/4 × 19 - M2	
13 3/4 × 21 - M	
14 1/2 × 15 - M	
14 1/2 × 21 - M	
14 1/2 × 23 - M	
14 1/2 × 25 - M	
14 1/2 × 27 - M	
14 7/8 × 21 - M	
15 × 19 - M	
15 1/4 × 15 - M	
15 1/4 × 17 - M	
15 3/4 × 13 - M	

Counter rotation model

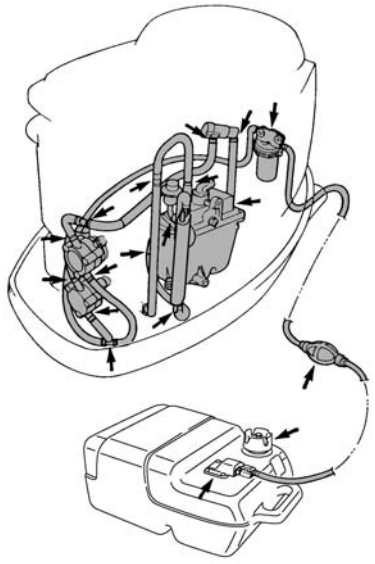
Propeller size (in)	Material
14 × 19 - ML	Aluminum
14 1/2 × 17 - ML	
13 3/8 × 23 - ML	Stainless
13 3/4 × 17 - ML1	
13 3/4 × 19 - ML1	
13 3/4 × 21 - ML	
14 1/2 × 23 - ML	
14 7/8 × 21 - ML	
15 1/4 × 15 - ML	
15 1/4 × 17 - ML	
15 1/4 × 19 - ML	

Predelivery checks

To make the delivery process smooth and efficient, the predelivery checks should be completed as explained below.

Checking the fuel system

1. Check that the fuel hoses are securely connected and that the fuel tank is full with fuel.



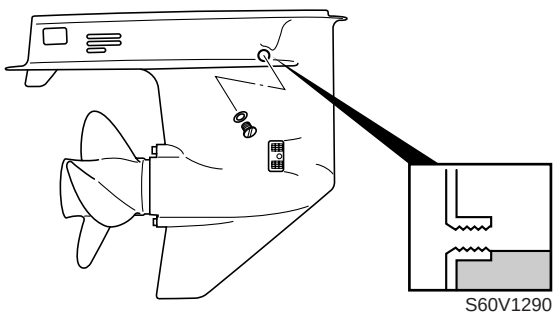
S63P1030

CAUTION:

This is a 4-stroke engine. Never use premixed fuel.

Checking the gear oil level

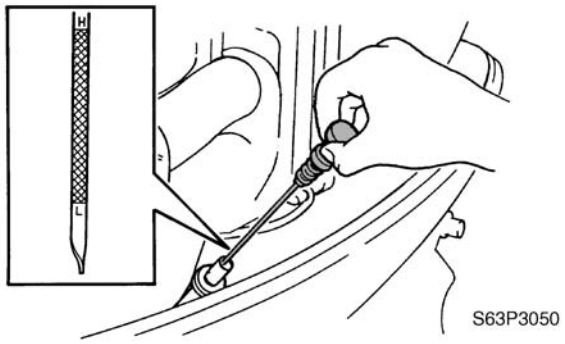
1. Check the gear oil level.



S60V1290

Checking the engine oil level

1. Check the engine oil level.



S63P3050

NOTE:

- If the engine oil is above the maximum level mark (H), extract sufficient oil with an oil changer or drain it until the level is between (H) and (L).
- If the engine oil is below the minimum level mark (L), add sufficient oil until the level is between (H) and (L).

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, or SJ
SAE: 10W-30 or 10W-40
Oil capacity:
Without oil filter replacement:
5.2 L (5.5 US qt, 4.6 Imp qt)

Checking the battery

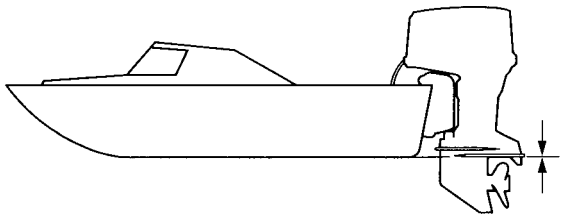
1. Check the capacity, electrolyte level, and specified gravity of the battery.

Recommended battery capacity:
CCA/EN: 711 A
20HR/IEC: 100 Ah
Electrolyte specified gravity:
1.280 at 20 °C (68 °F)

2. Check that the positive and negative battery leads are securely connected.

Checking the outboard motor mounting height

1. Check that the anti-cavitation plate is aligned with the bottom of the boat. If the mounting height is too high, cavitation will occur and propulsion will be reduced. Also, the engine speed will increase abnormally and cause the engine to overheat. If the mounting height is too low, water resistance will increase and reduce engine efficiency.



S69J1160

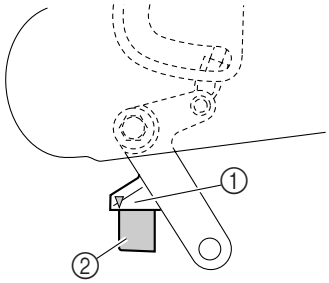
NOTE:
The optimum mounting height is affected by the combination of the boat and the outboard motor. To determine the optimum mounting height, test run the outboard motor at different heights.

2. Check that the clamp brackets are secured with the clamp bolts.

Checking the remote control cables

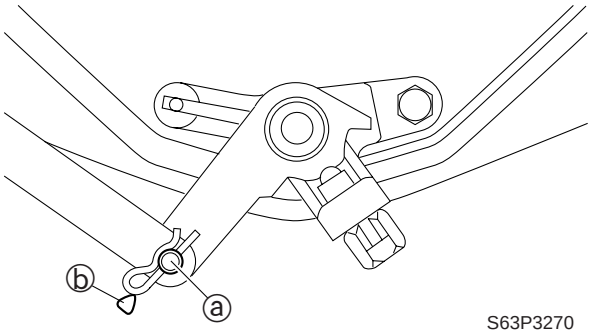
1. Set the remote control lever to the neutral position and fully close the throttle lever.

2. Check that the stopper ① on the throttle lever 2 contacts the fully closed stopper ② on the cylinder block.

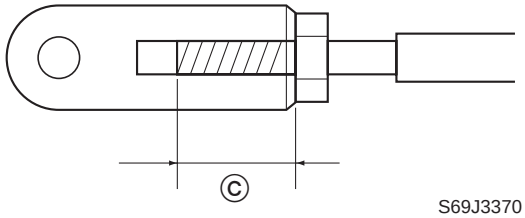


S63P1040

3. Check that the center of the set pin ⓐ is aligned with the alignment mark ⓑ on the bottom cowling.



S63P3270



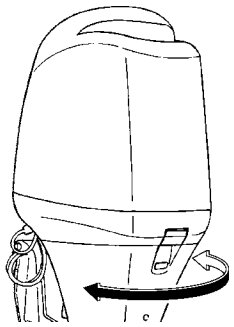
S69J3370

CAUTION:
The shift/throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⓒ.

Checking the steering system

1. Check the steering friction for proper adjustment.

2. Check that the steering operates smoothly.



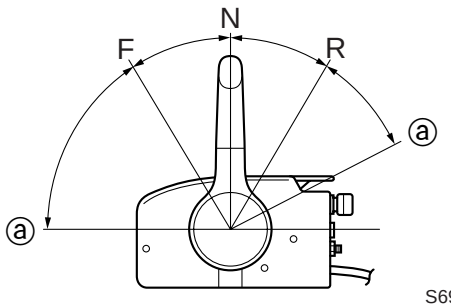
S63P1060

3. Check that there is no interference with wires or hoses when the outboard motor is steered.

Checking the gear shift and throttle operation

1. Check that the gear shift operates smoothly when the remote control lever is shifted from neutral to forward or reverse.

2. Check that the throttle operates smoothly when the remote control lever is shifted from forward or reverse to the fully open position ⓐ.



S69J1210

Checking the power trim and tilt system

1. Check that the outboard motor tilts up and down smoothly when operating the power trim and tilt unit.

2. Check that there is no abnormal noise produced when the outboard motor is tilted up or down.

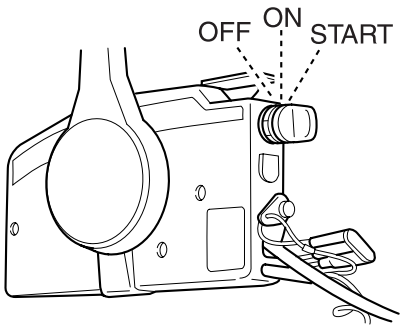
3. Check that there is no interference with wires or hoses when the tilted-up outboard motor is steered.

4. Check that the trim meter points down when the outboard motor is tilted all the way down.

Checking the engine start switch and engine stop lanyard switch

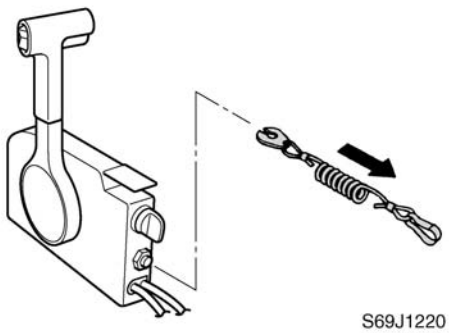
1. Check that the engine starts when the engine start switch is turned to START.

2. Check that the engine turns off when the engine start switch is turned to OFF.



S60V1070

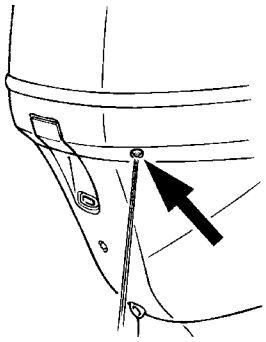
3. Check that the engine turns off when the engine stop lanyard is pulled from the engine stop lanyard switch.



S69J1220

Checking the cooling water pilot hole

1. Check that cooling water is discharged from the cooling water pilot hole.



S63P3120

Test run

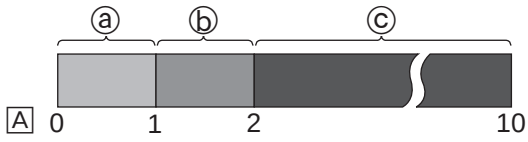
1. Start the engine, and then check that the gear shift operates smoothly.
2. Check the engine idle speed after the engine has been warmed up.
3. Operate at trolling speed.
4. Run the outboard motor for 1 hour at 2,000 r/min or at half throttle, then for another hour at 3,000 r/min or at 3/4 throttle.
5. Check that the outboard motor does not tilt up when shifting into reverse and that water does not flow in over the transom.

NOTE:
The test run is part of the break-in operation.

Break-in

During the test run, perform the break-in operation in the following three stages.

1. One hour ⓐ at 2,000 r/min or at approximately half throttle
2. One hour ⓑ at 3,000 r/min or 3/4 throttle and 1 minute out of every 10 at full throttle
3. Eight hours ⓒ at any speed, however, avoid running at full speed for more than 5 minutes



S69J1240

A Hour

After test run

1. Check for water in the gear oil.
2. Check for fuel leakage in the cowling.
3. Flush the cooling water passage with fresh water using the flushing kit and with the engine running at idle.

Specifications

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General specifications

Item	Unit	Model	
		Killer Whale 150	Killer Whale 150 SX
Dimension			
Overall length	mm (in)	822 (32.4)	
Overall width	mm (in)	511 (20.1)	
Overall height			
(L)	mm (in)	1,714 (67.5)	
(X)	mm (in)	1,842 (72.5)	
Boat transom height			
(L)	mm (in)	508 (20.0)	
(X)	mm (in)	635 (25.0)	
Weight			
(with aluminium propeller)			
(L)	kg (lb)	214.0 (472)	
(X)	kg (lb)	218.0 (481)	
(with stainless propeller)			
(L)	kg (lb)	216.0 (476)	
(X)	kg (lb)	220.0 (485)	
Performance			
Maximum output	kW (hp)	110.3 (150) at 5,500 r/min	
Full throttle operating range	r/min	5,000–6,000	
Maximum fuel consumption	L (US gal, lmp gal)/hr	55.8 (14.7, 12.3) at 6,000 r/min	
Engine idle speed	r/min	700 ± 50	
Power unit			
Type		4-stroke L	
Cylinder quantity		4	
Total displacement	cm^3 (cu. in)	2,670 (162.9)	
Bore × stroke	mm (in)	94.0 × 96.2 (3.70 × 3.79)	
Compression ratio		9.0	
Control system		Remote control	
Starting system		Electric	
Fuel system		Fuel injection	
Ignition system		TCI	
Maximum generator output	V, A	12, 35	
Spark plug		LFR5A-11 (NGK)	
Cooling system		Water	
Exhaust system		Propeller boss	
Lubrication system		Wet sump	

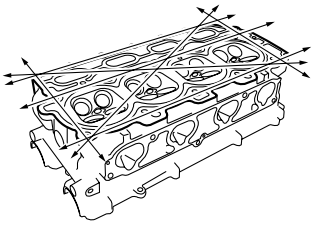
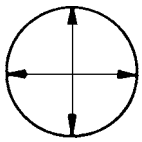
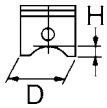
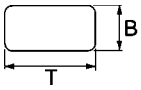
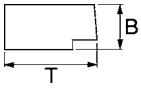
Item	Unit	Model	
		Killer Whale 150	Killer Whale 150 SX
Fuel and oil			
Fuel type		Regular unleaded gasoline	
Fuel minimum rating	RON(*1)	91	
	PON	86	
Engine oil		4-stroke motor oil	
Engine oil grade	API	SE, SF, SG, SH, or SJ	
	SAE	10W-30 or 10W-40	
Engine oil quantity			
(without oil filter replacement)	L (US qt, lmp qt)	5.2 (5.5, 4.6)	
(with oil filter replacement)	L (US qt, lmp qt)	5.4 (5.7, 4.8)	
Gear oil type		Hypoid gear oil	
Gear oil grade	SAE	90	
Gear oil quantity	cm^3 (US oz, lmp oz)	980 (33.1, 34.6)	870 (29.4, 30.7)
Bracket unit			
Trim angle (at 12° boat transom)	Degree	–4.0 to 16.0	
Tilt-up angle	Degree	70.0	
Steering angle	Degree	35.0 + 35.0	
Drive unit			
Gear shift positions		F-N-R	
Gear ratio		2.00 (28/14)	
Reduction gear type		Spiral bevel gear	
Clutch type		Dog clutch	
Propeller shaft type		Spline	
Propeller direction (rear view)		Clockwise	Counterclockwise
Propeller mark		M	ML
Electrical			
Battery minimum capacity(*2)			
CCA/EN	A	711	
20HR/IEC	Ah	100	

(*1) RON: Research Octane Number
PON: Pump Octane Number =
(RON + Motor Octane Number)/2

(*2) CCA: Cold Cranking Ampere
EN: European Norm (European standard)
IEC: International Electrotechnical Commission

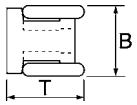
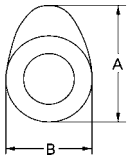
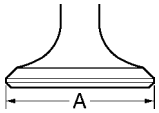
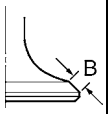
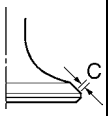
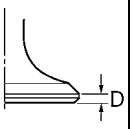
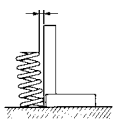
Maintenance specification

Power unit

Item	Unit	Model	
		Killer Whale 150	Killer Whale 150 SX
Power unit			
Minimum compression pressure(*1)	kPa (kgf/cm^2, psi)	880 (8.8, 128)	
Lubrication oil pressure(*2)	kPa (kgf/cm^2, psi)	450 (4.5, 65.3) at engine idle speed	
Cylinder head			
Warpage limit	mm (in)	0.10 (0.0039)	
 (lines indicate straightedge position)			
Camshaft cap inside diameter	mm (in)	25.000–25.021 (0.9843–0.9851)	
Cylinders			
Bore size 	mm (in)	94.000–94.017 (3.7008–3.7014)	
Taper limit	mm (in)	0.08 (0.0032)	
Out-of-round limit	mm (in)	0.05 (0.0020)	
Pistons			
Piston diameter (D) 	mm (in)	93.928–93.934 (3.6979–3.6982)	
Measuring point (H)	mm (in)	5.0 (0.20)	
Piston-to-cylinder clearance	mm (in)	0.075–0.080 (0.0030–0.0031)	
Piston pin boss bore	mm (in)	21.004–21.015 (0.8269–0.8274)	
Piston rings			
Top ring			
Dimension B 	mm (in)	1.17–1.19 (0.0461–0.0469)	
Dimension T	mm (in)	2.80–3.00 (0.1102–0.1181)	
End gap	mm (in)	0.15–0.30 (0.0059–0.0118)	
Side clearance	mm (in)	0.04–0.08 (0.0016–0.0031)	
2nd piston ring			
Dimension B 	mm (in)	1.17–1.19 (0.0461–0.0469)	
Dimension T	mm (in)	3.70–3.90 (0.1457–0.1535)	
End gap	mm (in)	0.30–0.45 (0.0118–0.0177)	
Side clearance	mm (in)	0.03–0.07 (0.0012–0.0028)	

(*1) Measure conditions:
Ambient temperature 20 °C (68 °F), wide open throttle, with spark plugs removed from all cylinders.
The figures are for reference only.

(*2) The figures are for reference only.

Item	Unit	Model	
		Killer Whale 150	Killer Whale 150 SX
Oil ring			
Dimension B 	mm (in)	2.40–2.47 (0.0945–0.0972)	
Dimension T	mm (in)	2.30–2.70 (0.0906–0.1063)	
End gap	mm (in)	0.15–0.60 (0.0059–0.0236)	
Side clearance	mm (in)	0.04–0.13 (0.0016–0.0051)	
Camshafts			
Intake (A) 	mm (in)	45.300–45.400 (1.7835–1.7874)	
Exhaust (A)	mm (in)	44.350–44.450 (1.7461–1.7500)	
Intake and exhaust (B)	mm (in)	35.950–36.050 (1.4154–1.4193)	
Camshaft journal diameter	mm (in)	24.960–24.980 (0.9827–0.9835)	
Camshaft journal oil clearance	mm (in)	0.020–0.060 (0.0008–0.0024)	
Camshaft runout limit	mm (in)	0.03 (0.0012)	
Valves			
Valve clearance (cold)			
Intake	mm (in)	0.20 ± 0.03 (0.008 ± 0.001)	
Exhaust	mm (in)	0.34 ± 0.03 (0.013 ± 0.001)	
Head diameter (A)			
Intake 	mm (in)	34.85–35.15 (1.37–1.38)	
Exhaust	mm (in)	29.85–30.15 (1.18–1.19)	
Face width (B)			
Intake 	mm (in)	2.11 (0.0831)	
Exhaust	mm (in)	2.43 (0.0957)	
Seat contact width (C)			
Intake 	mm (in)	1.10–1.40 (0.0433–0.0551)	
Exhaust	mm (in)	1.40–1.70 (0.0551–0.0669)	
Margin thickness (D)			
Intake 	mm (in)	0.70 (0.0276)	
Exhaust	mm (in)	1.00 (0.0394)	
Stem diameter			
Intake	mm (in)	5.477–5.492 (0.2156–0.2162)	
Exhaust	mm (in)	5.464–5.479 (0.2151–0.2157)	
Guide inside diameter			
Intake and exhaust	mm (in)	5.504–5.522 (0.2167–0.2174)	
Stem-to-guide clearance			
Intake and exhaust	mm (in)	0.025–0.058 (0.0010–0.0023)	
Stem runout limit	mm (in)	0.01 (0.0004)	
Valve springs			
Free length 	mm (in)	44.20 (1.7402)	
Minimum free length	mm (in)	42.60 (1.6771)	
Tilt limit	mm (in)	1.5 (0.06)	

Item	Unit	Model	
		Killer Whale 150	Killer Whale 150 SX
Valve lifters			
Valve lifter outside diameter	mm (in)	32.982–32.997 (1.2985–1.2990)	
Valve lifter-to-cylinder head clearance	mm (in)	0.020–0.055 (0.0008–0.0022)	
Valve shims			
Valve shim thickness (in 0.020 mm increments)	mm (in)	2.3–2.9 (0.09–0.12)	
Connecting rods			
Big-end inside diameter	mm (in)	53.025–53.045 (2.0876–2.0884)	
Crankpin oil clearance	mm (in)	0.027–0.052 (0.0011–0.0020)	
Big-end bearing thickness			
Green	mm (in)	1.496–1.502 (0.0589–0.0591)	
Blue	mm (in)	1.505–1.511 (0.0593–0.0595)	
Red	mm (in)	1.514–1.520 (0.0596–0.0598)	
Crankshaft			
Crankshaft journal diameter	mm (in)	51.980–52.000 (2.0465–2.0472)	
Crankpin diameter	mm (in)	49.980–50.000 (1.9677–1.9685)	
Crankpin width	mm (in)	22.00–22.10 (0.8661–0.8701)	
Runout limit	mm (in)	0.03 (0.0012)	
Crankcase			
Crankshaft main journal oil clearance	mm (in)	0.021–0.050 (0.0008–0.0020)	
Upper crankcase main journal bearing thickness			
Green	mm (in)	2.506–2.509 (0.0987–0.0988)	
Red	mm (in)	2.512–2.515 (0.0989–0.0990)	
Yellow	mm (in)	2.518–2.521 (0.0991–0.0993)	
Lower crankcase main journal bearing thickness			
Green	mm (in)	2.506–2.509 (0.0987–0.0988)	
Red	mm (in)	2.512–2.515 (0.0989–0.0990)	
Yellow	mm (in)	2.518–2.521 (0.0991–0.0993)	
Blue + green	mm (in)	2.524–2.527 (0.0994–0.0995)	
Main journal bearing #3 thickness (lower)			
Green	mm (in)	2.504–2.509 (0.0986–0.0988)	
Red	mm (in)	2.510–2.515 (0.0988–0.0990)	
Yellow	mm (in)	2.516–2.521 (0.0991–0.0993)	

Item	Unit	Model	
		Killer Whale 150	Killer Whale 150 SX
Oil pump			
Discharge at 97–103 °C (207–217 °F) with 10W-30 engine oil	L (US gal, lmp gal)/min	8.0 (2.113, 1.760) at 700 r/min	
Pressure	kPa (kgf/cm^2, psi)	132.0–162.0 (1.32–1.62, 19.1–23.5)	
Relief valve opening pressure	kPa (kgf/cm^2, psi)	392–490 (3.92–4.90, 56.84–71.05)	
Thermostats			
Opening temperature	°C (°F)	58–62 (136–144)	
Fully open temperature	°C (°F)	70 (158)	
Valve open lower limit	mm (in)	4.3 (0.17)	

Lower unit

Item	Unit	Model	
		Killer Whale 150	Killer Whale 150 SX
Gear backlash			
Pinion-to-forward gear	mm (in)	0.14–0.46 (0.0055–0.0181)	0.14–0.42 (0.0055–0.0165)
Pinion-to-reverse gear	mm (in)	0.32–0.67 (0.0126–0.0264)	0.23–0.58 (0.0090–0.0228)
Pinion shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	
Forward gear shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	
Reverse gear shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50	
Propeller shaft shims	mm	—	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50
Propeller shaft			
End play	mm (in)	—	0.25–0.35 (0.0098–0.0138)

Electrical

Item	Unit	Model	
		Killer Whale 150	Killer Whale 150 SX
Ignition and ignition control system			
Ignition timing (cylinder #1)	Degree	TDC at engine idle speed	
Spark plug gap	mm (in)	1.0–1.1 (0.039–0.043)	
Ignition coil resistance			
Primary coil (R – B/W)			
at 20 °C (68 °F)	Ω	1.53–2.07	
Secondary coil			
at 20 °C (68 °F)	kΩ	12.50–16.91	
ECM output peak voltage (B/O, B/W – B)			
at cranking (loaded)	V	260	
at 1,500 r/min (loaded)	V	260	
at 3,500 r/min (loaded)	V	270	
Pulser coil output peak voltage (W/R, W/B – B)			
at cranking (unloaded)	V	3.5	
at cranking (loaded)	V	3.6	
at 1,500 r/min (loaded)	V	23.9	
at 3,500 r/min (loaded)	V	49.7	
Pulser coil resistance(*1) (W/R, W/B – B)	Ω	459–561	
Pulser coil air gap	mm (in)	0.3–0.7 (0.0118–0.0276)	
Throttle position sensor			
Input voltage (O – B)	V	5	
Output voltage (P – B)	V	0.70 ± 0.02 at engine idle speed	
Intake air temperature sensor resistance			
at 20 °C (68 °F)	kΩ	2.20–2.70	
Engine temperature sensor resistance (B/Y – B/Y)			
at 20 °C (68 °F)	kΩ	54.2–69.0	
at 100 °C (212 °F)	kΩ	3.12–3.48	
Fuel control system			
Fuel injector resistance(*1)			
at 20 °C (68 °F)	Ω	14.0–15.0	

(*1) The figures are for reference only.

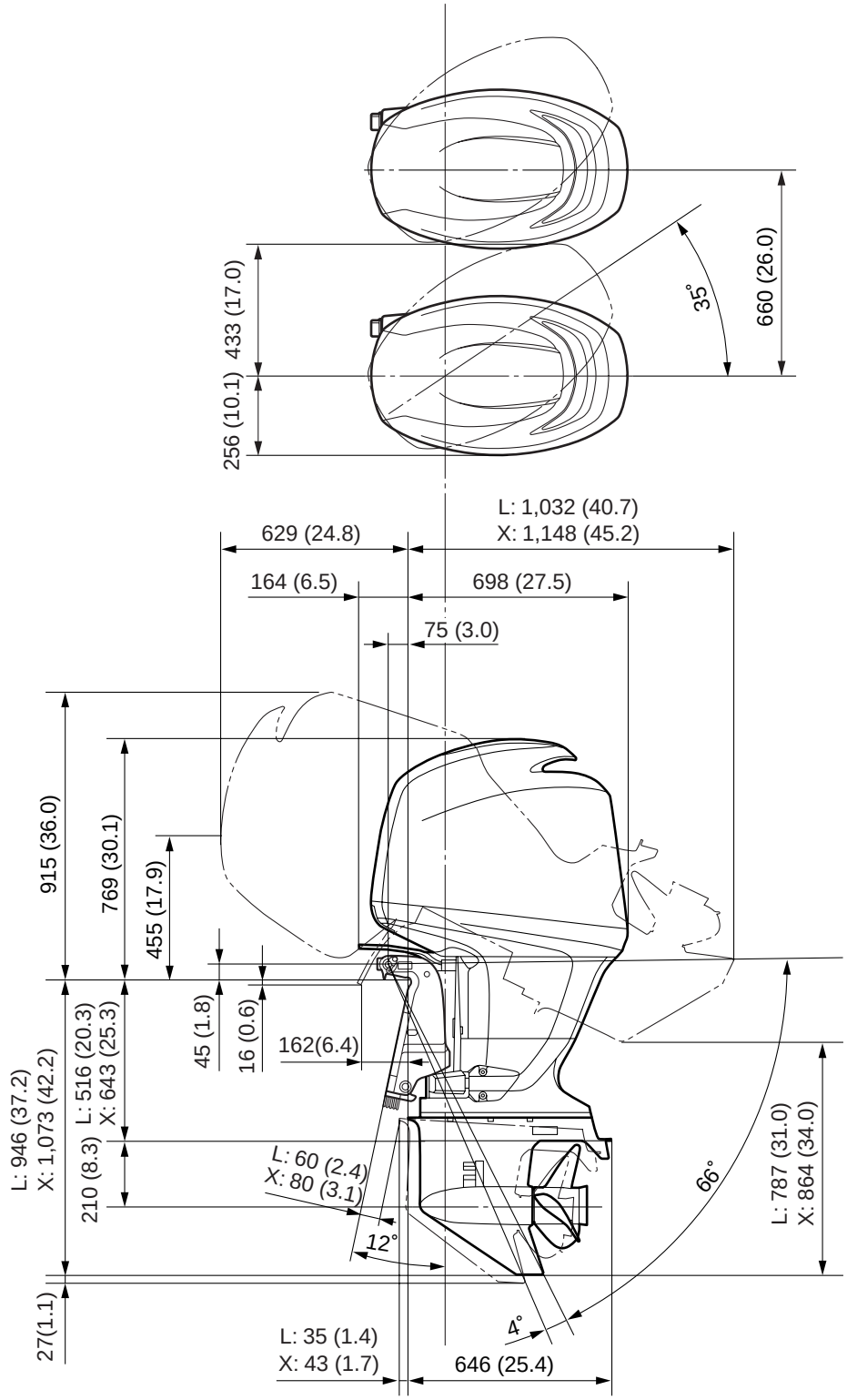
Item	Unit	Model	
		Killer Whale 150	Killer Whale 150 SX
Starter motor			
Type		Sliding gear	
Output	kW	1.40	
Cranking time limit	Second	30	
Brushes			
Standard length	mm (in)	15.5 (0.61)	
Wear limit	mm (in)	9.5 (0.37)	
Commutator			
Standard diameter	mm (in)	29.0 (1.14)	
Wear limit	mm (in)	28.0 (1.10)	
Mica			
Standard undercut	mm (in)	0.5–0.8 (0.02–0.03)	
Wear limit	mm (in)	0.2 (0.01)	
Charging system			
Fuse	A	20, 30, 50	
Stator coil output peak voltage (G – G)			
at cranking (unloaded)	V	12	
at 1,500 r/min (unloaded)	V	50	
at 3,500 r/min (unloaded)	V	110	
Stator coil resistance(*1)			
at 20 °C (68 °F) (G – G)	Ω	0.20–0.30	
Rectifier Regulator output peak voltage (R – B)			
at 1,500 r/min (unloaded)	V	13.0	
at 3,500 r/min (unloaded)	V	13.0	
Power trim and tilt system			
Trim sensor			
Setting resistance (P – B)	Ω	9–11	
Resistance (P – B)	Ω	9–378.8	
Fluid type		ATF Dexron II	
Brushes			
Standard length	mm (in)	9.8 (0.39)	
Wear limit	mm (in)	4.8 (0.19)	
Commutator			
Standard limit	mm (in)	22.0 (0.87)	
Wear limit	mm (in)	21.0 (0.83)	
Mica			
Standard undercut	mm (in)	1.3 (0.05)	
Wear limit	mm (in)	0.8 (0.03)	

(*1) The figures are for reference only.

Dimensions

Exterior

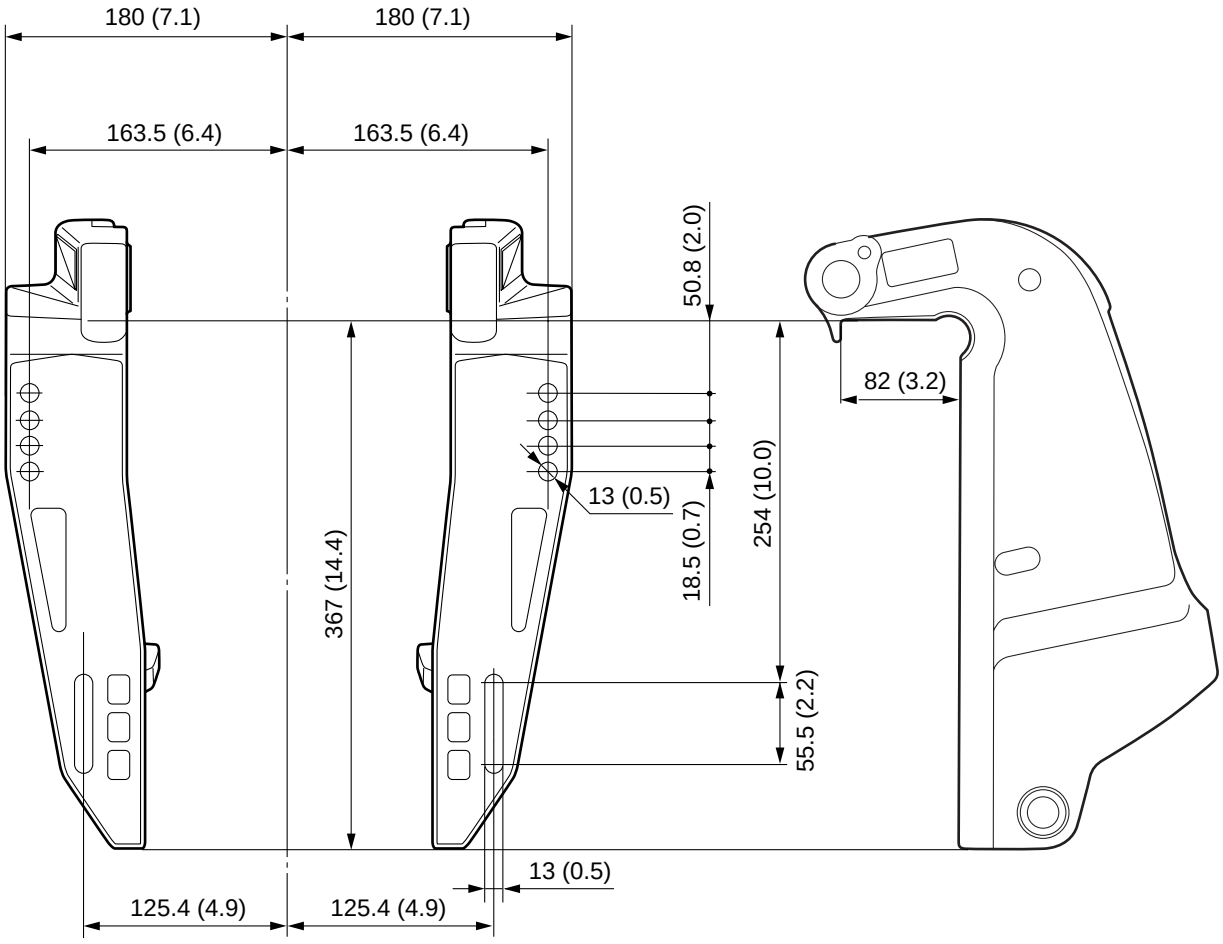
mm (in)



S63P2010

Clamp bracket

mm (in)



S63P2020

Tightening torques

Specified torques

Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Fuel system					
Fuel filter holder bolt		M6	8	0.8	5.9
Fuel filter bracket bolt		M6	8	0.8	5.9
Fuel pump mounting bolt		M6	10	1.0	7.4
Fuel pump screw		ø6	4	0.4	3.0
Fuel cooler bolt		M6	5	0.5	3.7
Vapor separator mounting bolt		M6	5	0.5	3.7
Fuel rail mounting bolt		M8	13	1.3	9.6
Throttle body mounting bolt		M8	13	1.3	9.6
Power unit					
Power unit mounting bolt		M8	20	2.0	14.8
		M10	42	4.2	31.0
Apron bolt		M6	8	0.8	5.9
Apron screw		ø6	4	0.4	3.0
Flywheel magnet nut		(M24)	270	27.0	199.1
Starter motor bolt		M8	29	2.9	21.4
Starter motor terminal nut		(M8)	9	0.9	6.6
Starter relay lead bolt		M6	4	0.4	3.0
Ignition coil bolt		M6	7	0.7	5.2
Oil filter		—	18	1.8	13.3
PTT relay nut		(M6)	4	0.4	3.0
PTT motor lead bolt		M6	4	0.4	3.0
Positive battery cable nut		(M8)	9	0.9	6.6
Timing belt tensioner bolt		—	39	3.9	28.8
Drive sprocket bolt		M5	7	0.7	5.2
Driven sprocket bolt		M10	60	6.0	44.3
Camshaft cap bolt	1st	M7	8	0.8	5.9
	2nd		17	1.7	12.5
Cylinder head cover plate screw		ø4	2	0.2	1.5
Cylinder head cover bolt	1st	M6	8	0.8	5.9
	2nd		8	0.8	5.9
Cylinder head bolt	1st	M8	14	1.4	10.3
	2nd		28	2.8	20.7
	1st	M10	19	1.9	14.0
	2nd		37	3.7	27.3
	3rd		90°		
Spark plug		—	25	2.5	18.4
Engine temperature sensor		—	15	1.5	11.1
Cylinder block plug		M14	23	2.3	17.0
Engine hanger bolt		M6	12	1.2	8.9
Oil pressure sensor		—	18	1.8	13.3

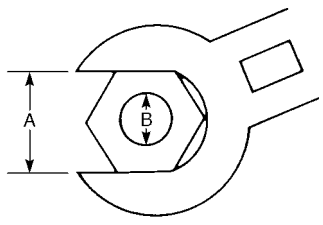
Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Exhaust cover bolt	1st	M6	6	0.6	4.4
	2nd		12	1.2	8.9
Thermostat cover bolt	1st	M6	6	0.6	4.4
	2nd		12	1.2	8.9
Exhaust cover plug		M14	23	2.3	17.0
		M18	55	5.5	40.6
Oil filter union bolt		—	34	3.4	25.1
Balancer bolt	1st	M6	7	0.7	5.2
	2nd		13	1.3	9.6
	1st	M8	18	1.8	13.3
	2nd		31	3.1	22.9
Oil pump screw		—	4	0.4	3.0
Crankcase bolt	1st	M8	14	1.4	10.3
	2nd		26	2.6	19.2
	1st	M10	30	3.0	22.1
	2nd		90°		
Main bearing cap bolt	1st	M10	30	3.0	22.1
	2nd		90°		
Connecting rod cap	1st	—	23	2.3	17.0
	2nd		43	4.3	31.7
	3rd		90°		
Lower unit (regular rotation model)					
Gear oil drain screw		—	9	0.9	6.6
Gear oil check screw		—	9	0.9	6.6
Lower case mounting bolt		M10	47	4.7	34.7
Trim tab bolt		M10	42	4.2	31.0
Propeller nut		(M18)	52	5.2	38.4
Ring nut		—	142	14.2	104.7
Cooling water inlet cover screw		—	4	0.4	3.0
Pinion nut		(M16)	93	9.3	68.6
Lower unit (counter rotation model)					
Gear oil drain screw		—	9	0.9	6.6
Gear oil check screw		—	9	0.9	6.6
Lower case mounting bolt		M10	47	4.7	34.7
Trim tab bolt		M10	42	4.2	31.0
Propeller nut		(M18)	52	5.2	38.4
Ring nut		—	142	14.2	104.7
Cooling water inlet cover screw		—	4	0.4	3.0
Pinion nut		(M16)	93	9.3	68.6
Bracket unit					
Shift rod detent bolt		—	18	1.8	13.3
Flushing hose adapter screw		ø6	3	0.3	2.2
Upper mount bracket bolt		M10	54	5.4	39.8

Part to be tightened	Thread size	Tightening torques		
		N·m	kgf·m	ft·lb
Muffler assembly bolt	M8	20	2.0	14.8
	M10	42	4.2	31.0
Engine oil drain bolt	M14	27	2.7	20.0
Baffle plate screw	ø5	4	0.4	3.0
Muffler bolt	M8	20	2.0	14.8
Exhaust manifold bolt	M8	20	2.0	14.8
Oil pan bolt	M8	20	2.0	14.8
Oil strainer bolt	M6	10	1.0	7.4
Upper mounting nut	(M14)	74	7.4	54.6
Lower mounting nut	(M14)	74	7.4	54.6
Trim stopper nut	(M10)	48	4.8	35.4
Self-locking nut	—	15	1.5	11.1
Trim sensor cam screw	ø6	2	0.2	1.5
Grease nipple	—	3	0.3	2.2
Power trim and tilt unit				
Reservoir cap	—	0.7	0.07	0.5
Reservoir mounting bolt	M6	5	0.5	3.7
PTT motor mounting bolt	M6	5	0.5	3.7
Gear pump cover bolt	—	6	0.6	4.4
Gear pump housing mounting bolt	—	8	0.8	5.9
Manual valve	—	3	0.3	2.2
Trim cylinder end screw	—	78	7.8	57.5
Tilt cylinder end screw	—	130	13.0	96.0
Tilt piston nut	—	96	9.6	70.8

General torques

This chart specifies tightening torques for standard fasteners with a standard ISO thread pitch. Tightening torque specifications for special components or assemblies are provided in applicable sections of this manual. To avoid warpage, tighten multi-fastener assemblies in a crisscross fashion and progressive stages until the specified torque is reached. Unless otherwise specified, torque specifications require clean, dry threads. Components should be at room temperature.

Nut (A)	Bolt (B)	General torque specifications		
		N·m	kgf·m	ft·lb
8 mm	M5	5	0.5	3.6
10 mm	M6	8	0.8	5.8
12 mm	M8	18	1.8	13
14 mm	M10	36	3.6	25
17 mm	M12	43	4.3	31



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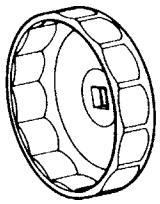
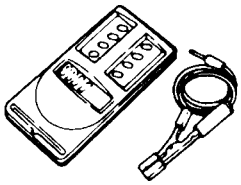
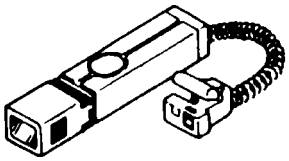
Special service tools



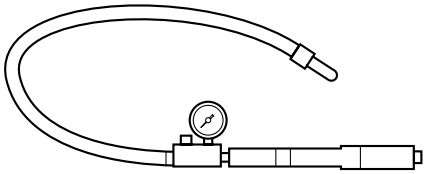
Oil filter wrench
90890-06830



Digital tachometer
90890-06760



Timing light
90890-03141



Leakage tester
90890-06840

Maintenance interval chart

Use the following chart as a guideline for general maintenance.
Adjust the maintenance intervals according to the operating conditions of the outboard motor.

Item	Remarks	Initial		Every		Refer to page
		10 hours (1 month)	50 hours (3 months)	100 hours (6 months)	200 hours (1 year)	
Anodes (external)	Check/replace		○	○		3-15
Battery	Check/charge	○				3-16
Cooling water passages	Clean		○	○		3-8
Top cowling	Check				○	3-3
Fuel filter (can be disassembled)	Check/replace	○	○	○		3-3
Fuel system	Check	○	○	○		3-3
Gear oil	Change	○		○		3-14
Lubrication points	Lubricate			○		3-16
Engine idle speed (EFI models)	Check/adjust				○	3-8
PCV (Pressure Control Valve)	Check				○	5-37
Power trim and tilt unit	Check				○	3-13
Propeller and cotter pin	Check/replace		○	○		3-15
Shift link/shift cable	Check/adjust				○	3-11
Thermostat	Check				○	3-7
Throttle link/throttle cable/ throttle pick-up timing	Check/adjust				○	3-8, 3-10
Water pump	Check				○	6-9, 6-37
Engine oil	Check/change	○		○		3-4
Oil filter	Change				○	3-5
Spark plugs	Clean/adjust/ replace	○			○	3-6
Timing belt	Check/replace			○	○	3-6, 5-16

NOTE:
When operating in salt water, turbid or muddy water, the engine should be flushed with clean water after each use.

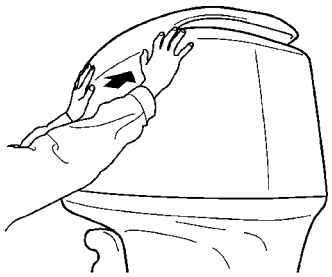
Item	Remarks	Every			Refer to page
		500 hours (2.5 years)	1,000 hours (5 years)	2,000 hours (10 years)	
Timing belt	Replace		○		5-16
Valve clearance (DOHC)	Check/adjust	○			5-12
Anodes (internal)	Check/replace		○		—
Balancer	Replace			○	—

NOTE:
When using lead or high-sulfur gasoline, checking valve clearance may be required more frequently than every 500 hours.

Top cowling

Checking the top cowling

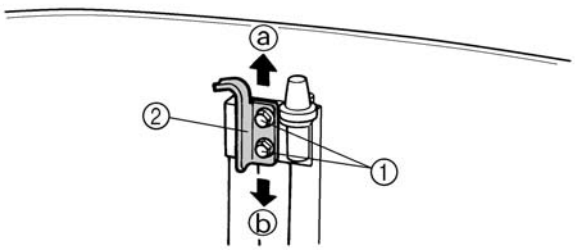
1. Check the fitting by pushing the cowling with both hands. Adjust if necessary.



S63P3010

2. Loosen the bolts ①.

3. Move the hook ② up or down slightly to adjust its position.



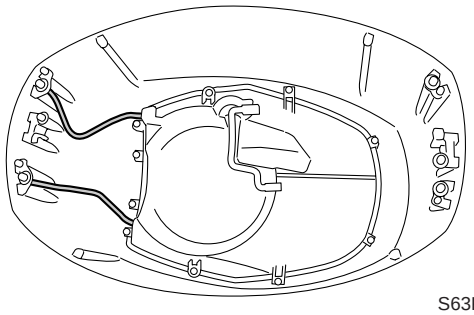
S63P3020

NOTE:
- To loosen the fitting, move the hook in direction ⓐ.
- To tighten the fitting, move the hook in direction ⓑ.

4. Tighten the bolts.

5. Check the fitting again and, if necessary, repeat steps 2–4.

6. Check the top cowling hose for cracks or damage. Replace if necessary.



S63P3030

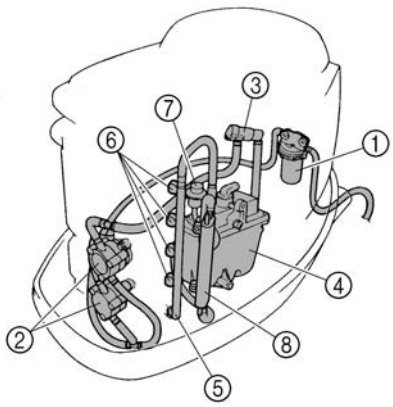
Fuel system

Checking the fuel joint and fuel hoses (fuel joint-to-fuel injector)

1. Remove the spark plug wire cover.

2. Check the low-pressure fuel hose connections and fuel joints for leaks. Replace if necessary. Also, check the fuel filter ①, fuel pumps ②, and fuel filter ③ for leaks or deterioration. Replace if necessary.

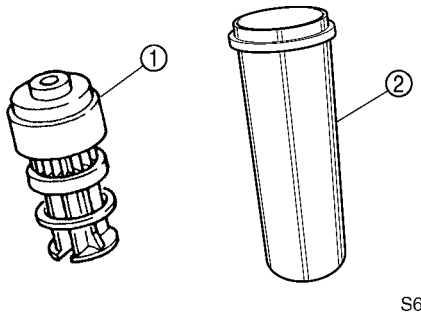
3. Check the high-pressure fuel hose connections for leaks. Replace if necessary. Also, check the vapor separator ④, fuel rail ⑤, fuel injectors ⑥, pressure regulator ⑦, and fuel cooler ⑧ for leaks or deterioration. Replace if necessary.



S63P3360

Checking the fuel filter

1. Check the fuel filter element ① for dirt and residue and check the fuel filter cup ② for foreign substances and cracks. Clean the cup with straight gasoline and replace the element if necessary.



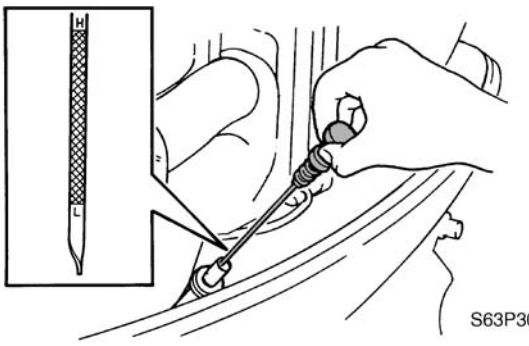
S69J3070

NOTE:
Be sure not to spill any fuel when removing the fuel filter cup.

Power unit

Checking the engine oil

1. Place the outboard motor in an upright position.
2. Remove the engine oil dipstick, wipe it clean, and then insert it back into the oil filler hole.
3. Remove the dipstick again to check the oil level and to check the oil for discoloration and its viscosity.

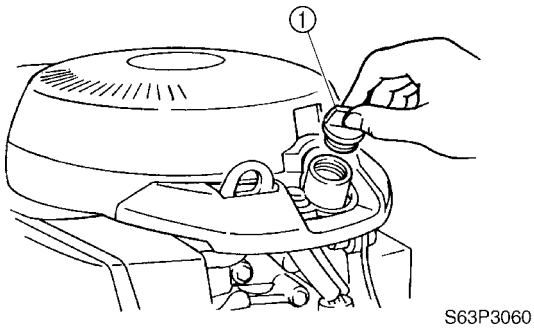


S63P3050

NOTE:
- Change the oil if it appears milky or dirty.
- If the engine oil is above the maximum level mark (H), extract sufficient oil using an oil changer or drain it until the level is between (H) and (L).
- If the engine oil is below the minimum level mark (L), add sufficient oil until the level is between (H) and (L).

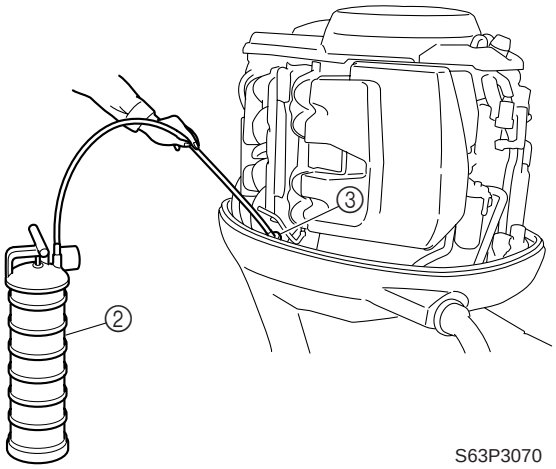
Changing the engine oil using an oil changer

1. Start the engine, warm it up, and then turn it off.
2. Remove the engine oil dipstick and oil filler cap ①.



S63P3060

3. Insert the tube of the oil changer ② into the dipstick guide ③.



S63P3070

4. Operate the oil changer to extract the oil.

NOTE:
Be sure to clean up any oil spills.

5. Pour the specified amount of the recommended engine oil into the oil filler hole.

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, or SJ
SAE: 10W-30 or 10W-40
Oil quantity:
Without oil filter replacement:
5.2 L (5.5 US qt, 4.6 Imp qt)

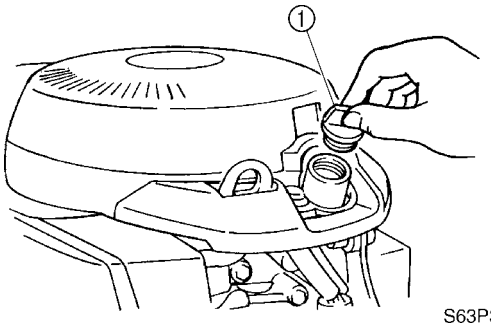
6. Install the oil filler cap and dipstick, and then start the engine and warm it up for 5 minutes.

7. Turn the engine off, and then check the oil level and correct it if necessary.

Changing the engine oil by draining it

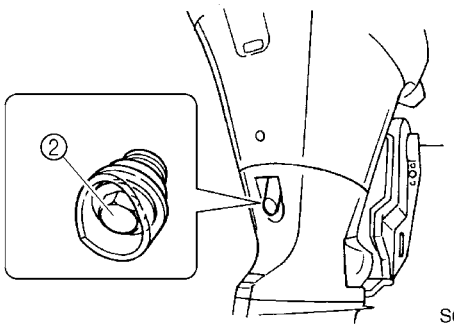
1. Start the engine, warm it up, and then turn it off.

2. Remove the engine oil dipstick and oil filler cap ①.



S63P3060

3. Place a drain pan under the drain hole, and then remove the drain bolt ② and let the oil drain completely.



S63P3080

NOTE:
Be sure to clean up any oil spills.

4. Install the drain bolt, and then tighten it to the specified torque.

Drain bolt:
27 N·m (2.7 kgf·m, 20.0 ft·lb)

5. Pour the specified amount of the recommended engine oil into the oil filler hole.

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, or SJ
SAE: 10W-30 or 10W-40
Oil quantity:
Without oil filter replacement:
5.2 L (5.5 US qt, 4.6 Imp qt)

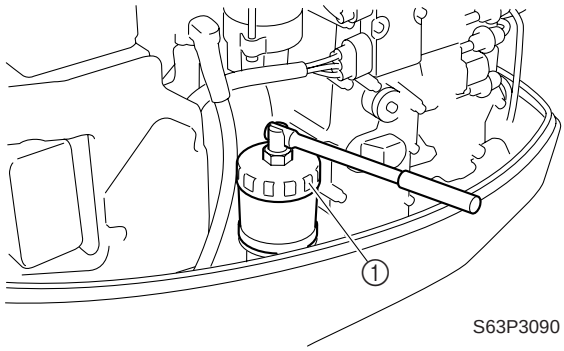
6. Install the oil filler cap and dipstick, and then start the engine and warm it up for 5 minutes.

7. Turn the engine off, and then check the oil level and correct it if necessary.

Replacing the oil filter

1. Extract the engine oil with an oil changer or drain it.

2. Place a rag under the oil filter, and then remove the oil filter using a 72.5 mm (2.9 in) oil filter wrench.



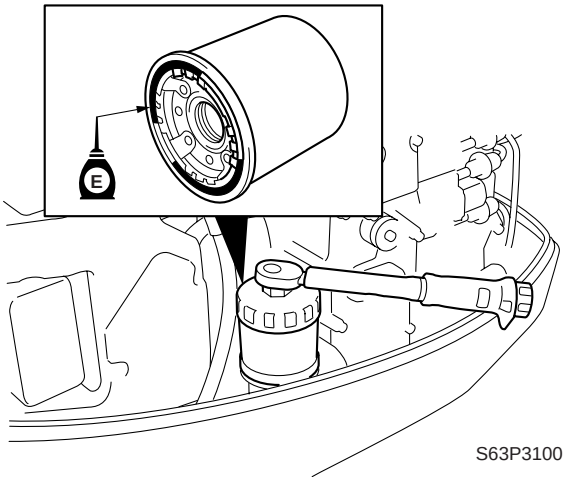
S63P3090

NOTE:
- Wait more than 5 minutes after turning the engine off to replace the oil filter.
- Be sure to clean up any oil spills.

Oil filter wrench ①: 90890-06830

3. Apply a thin coat of engine oil to the O-ring of the new oil filter.

4. Install the oil filter, and then tighten it to the specified torque using a 72.5 mm (2.9 in) oil filter wrench.



S63P3100

Oil filter:
18 N·m (1.8 kgf·m, 13.3 ft·lb)

5. Pour the specified amount of the recommended engine oil into the oil filler hole.

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, or SJ
SAE: 10W-30 or 10W-40
Oil quantity:
With oil filter replacement:
5.4 L (5.7 US qt, 4.8 Imp qt)

6. Install the oil filler cap and dipstick, and then start the engine and warm it up for 5 minutes.

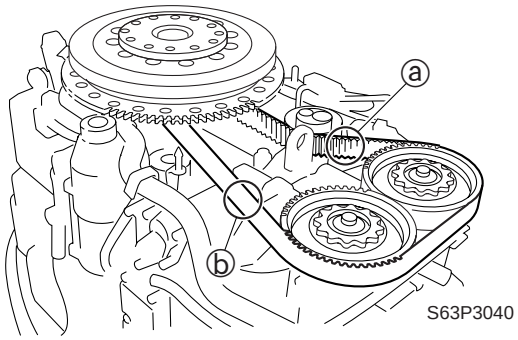
7. Turn the engine off, and then check the oil level and correct it if necessary.

Checking the timing belt

1. Remove the flywheel magnet cover.

2. While turning the flywheel magnet clockwise, check the interior ⓐ and the exterior ⓑ of the timing belt for cracks, damage, or wear. Replace if necessary.

3. Turn the crankshaft clockwise two turns to take up slack in the timing belt.



S63P3040

Replacing the timing belt

NOTE:
For replacement procedures, see Chapter 5, “Replacing the timing belt.”

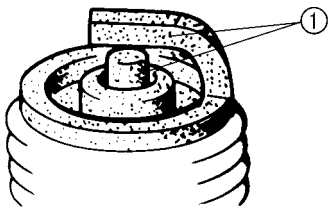
Checking the valve clearance

NOTE:
For checking procedures, see Chapter 5, “Checking the valve clearance.”

Checking the spark plugs

1. Disconnect the spark plug wires, and then remove the spark plugs.

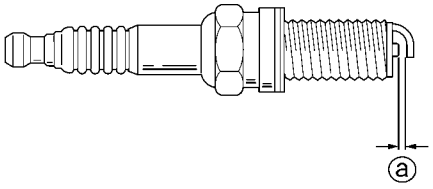
2. Clean the electrodes ① with a spark plug cleaner or wire brush. Replace the spark plug if necessary.



S69J3190

3. Check the electrodes for erosion and excessive carbon or other deposits, and the gasket for damage. Replace the spark plug if necessary.

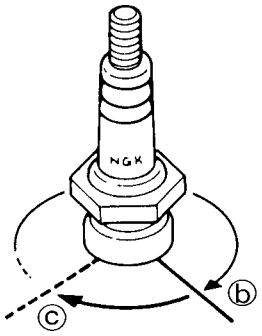
4. Check the spark plug gap ⓐ. Adjust if out of specification.



S69J3200

Specified spark plug:
LFR5A-11 (NGK)
Spark plug gap ⓐ:
1.0–1.1 mm (0.039–0.043 in)

5. Install the spark plugs, tighten them finger tight ⓑ, then to the specified torque using a spark plug wrench ⓒ.

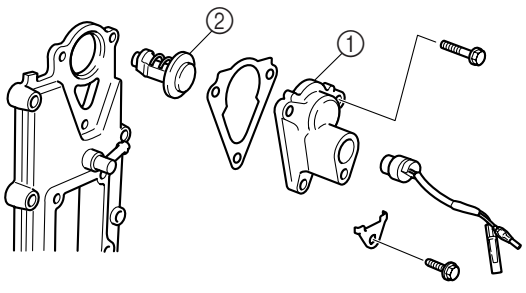


S69J3210

Spark plug:
25 N·m (2.5 kgf·m, 18.4 ft·lb)

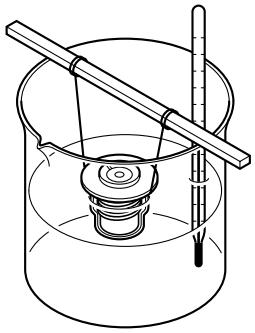
Checking the thermostat

1. Remove the flywheel magnet cover.
2. Remove the cover ① and thermostat ②.



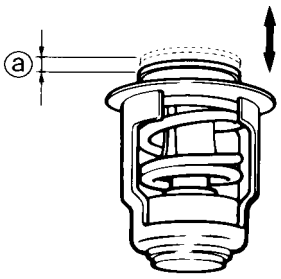
S63P3110

3. Suspend the thermostat in a container of water.
4. Place a thermometer in the water and slowly heat the water.



S69J5E40

5. Check the thermostat valve opening at the specified water temperatures. Replace if out of specification.



S69J5E50

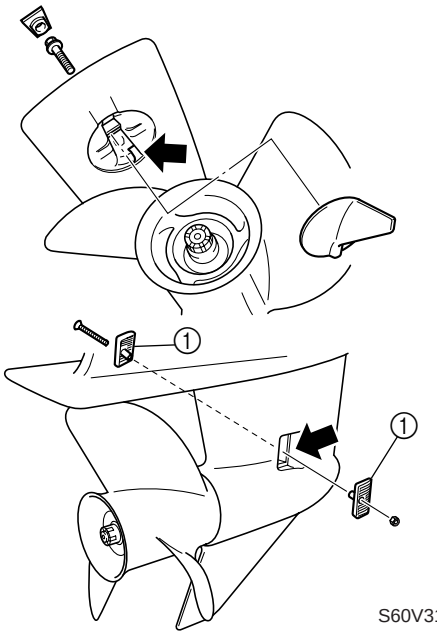
Water temperature	Valve lift ⓐ
58–62 °C (136–144 °F)	0.05 mm (0.0020 in) (valve begins to lift)
above 70 °C (158 °F)	more than 4.3 mm (0.17 in)

6. Install the thermostat and cover, and then tighten the cover bolts to the specified torques in two stages.

Thermostat cover bolt:
1st: 6 N·m (0.6 kgf·m, 4.4 ft·lb)
2nd: 12 N·m (1.2 kgf·m, 8.9 ft·lb)

Checking the cooling water passage

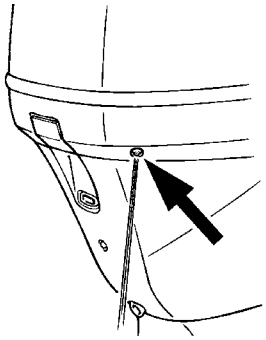
1. Check the cooling water inlet cover ① and cooling water inlet for clogs. Clean if necessary.



S60V3130

2. Place the lower unit in water, and then start the engine.

3. Check for water flow at the cooling water pilot hole. If there is no water flow, check the cooling water passage inside the outboard motor.

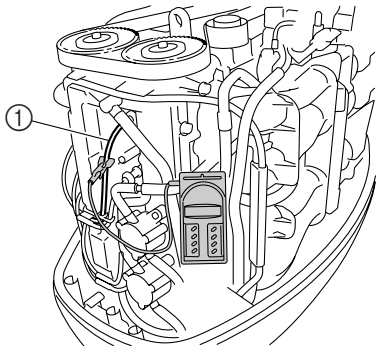

S63P3120

Control system

Checking the engine idle speed

1. Start the engine and warm it up for 5 minutes.

2. Attach the special service tool to spark plug wire #1 ①, and then check the engine idle speed.



S63P3140

Digital tachometer: 90890-06760

Engine idle speed: 700 ± 50 r/min

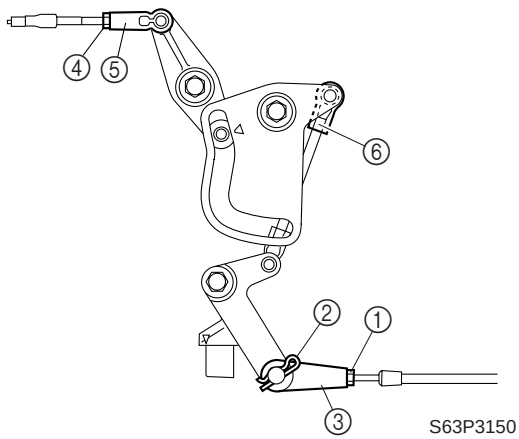
Adjusting the throttle link and throttle cable

NOTE:
- Be sure to synchronize the throttle valves before adjusting the throttle cable.
- For synchronizing procedures, see Chapter 4, “Synchronizing the throttle valves.”

1. Remove the intake silencer.

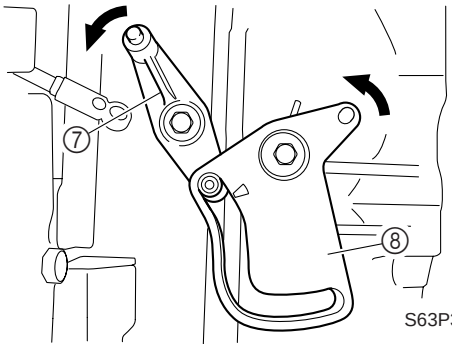
2. Loosen the locknut ①, remove the clip ②, and then disconnect the throttle cable joint ③.

3. Loosen the locknut ④, and then disconnect the throttle link rod joint ⑤ and the link rod joint ⑥.



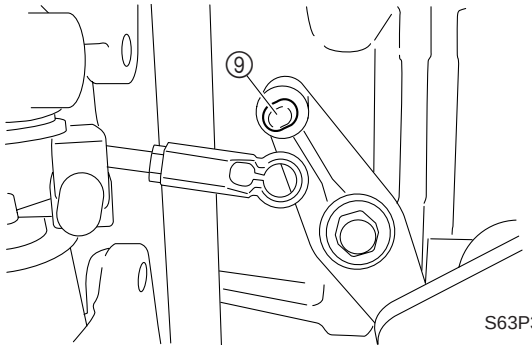
S63P3150

4. Turn throttle lever 1 ⑦ and the throttle cam ⑧ counterclockwise so that they are in the positions shown in the illustration.



S63P3160

5. Check that the throttle valves are fully closed, and then adjust the throttle link rod joint to align its hole with the ball joint ⑨ on throttle lever 1.

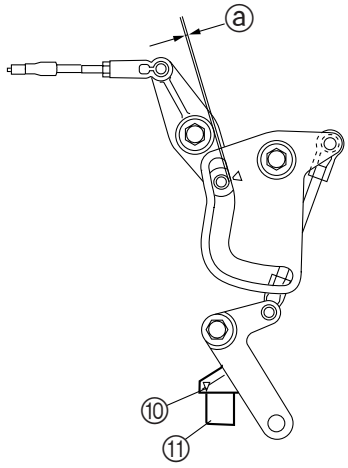


S63P3170

6. Connect the throttle link rod joint ⑤, and then tighten the locknut ④.

7. Connect the link rod joint ⑥.

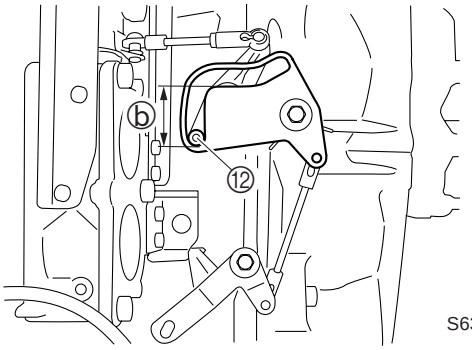
8. Contact the stopper ⑩ on the throttle lever 2 to the fully closed stopper ⑪ on the cylinder block and check for clearance ⓐ between the throttle cam roller and the throttle cam.



S63P3180

NOTE:
If there is no clearance, loosen the locknut ④ and the throttle link rod joint one turn, and then repeat steps 6 and 8.

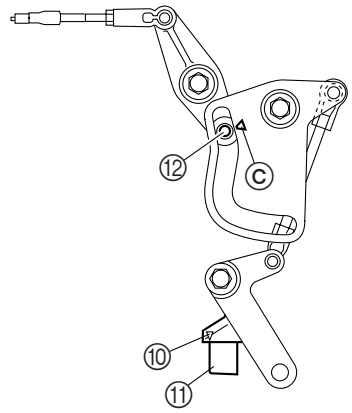
9. Operate throttle lever 2 to check that the throttle valves fully close and fully open.



S63P3190

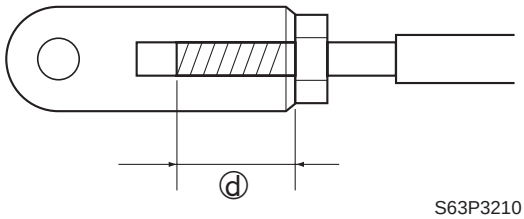
NOTE:
The throttle valves are fully open when the throttle cam roller ⑫ is within the range ⓑ shown in the illustration.

10. Contact the stopper ⑩ on the throttle lever 2 to the fully closed stopper ⑪ on the cylinder block and check that throttle cam roller ⑫ is aligned with the alignment mark ⓒ.



S63P3200

11. Adjust the position of the throttle cable joint until its hole is aligned with the set pin on throttle lever 2.



S63P3210

CAUTION:

The throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⓓ.

12. Connect the cable joint, install the clip, and then tighten the locknut.

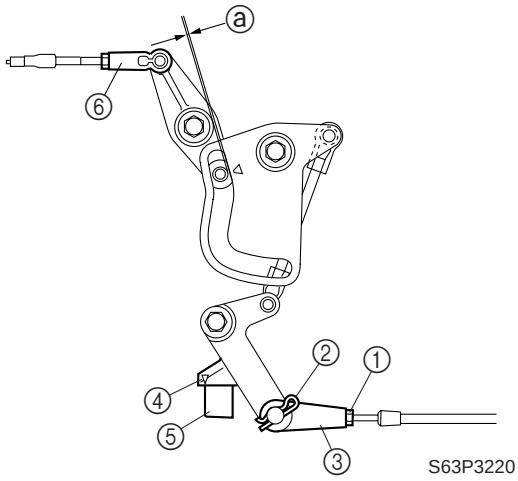
13. Check the throttle cable for smooth operation and, if necessary, repeat steps 1–12.

Adjusting the throttle link and throttle cable operation (using a thickness gauge)

1. Remove the intake silencer.

2. Loosen the locknut ①, remove the clip ②, and then disconnect the throttle cable joint ③.

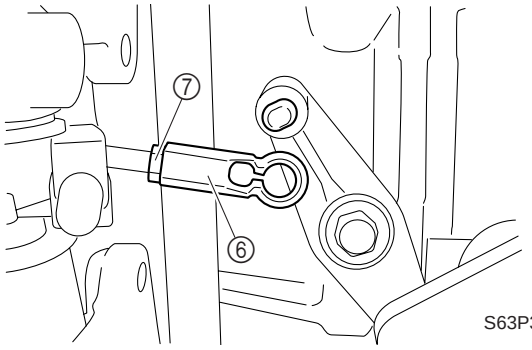
3. Contact the stopper ④ on the throttle lever 2 to the fully closed stopper ⑤ on the cylinder block and adjust the throttle link rod joint ⑥ so that the specified clearance ⓐ between the throttle cam roller and the throttle cam is obtained.



S63P3220

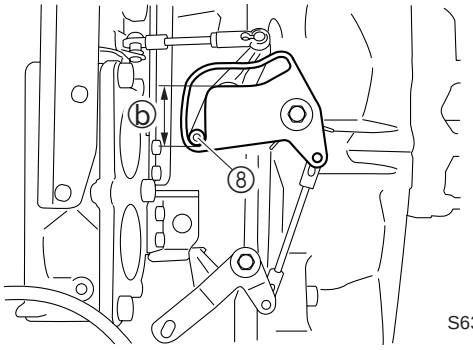
Clearance ⓐ: 0.5 mm (0.02 in)

4. Connect the throttle link rod joint ⑥, and then tighten the locknut ⑦.



S63P3230

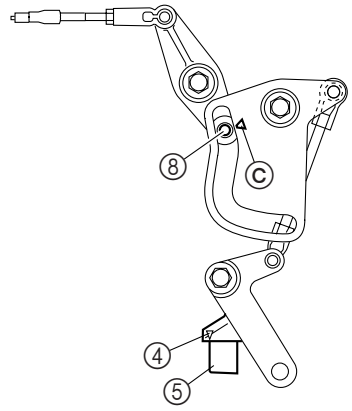
5. Operate throttle lever 2 to check that the throttle valves fully close and fully open.



S63P3240

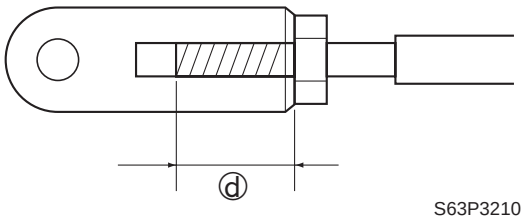
NOTE:
The throttle valves are fully open when the throttle cam roller ⑧ is within the range ⓑ shown in the illustration.

6. Contact the stopper ④ on the throttle lever 2 to the fully closed stopper ⑤ on the cylinder block and check that throttle cam roller ⑧ is aligned with the alignment mark ⓒ.



S63P3250

7. Adjust the position of the throttle cable joint until its hole is aligned with the set pin on throttle lever 2.



S63P3210

CAUTION:
The throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⓓ.

8. Connect the cable joint, install the clip, and then tighten the locknut.

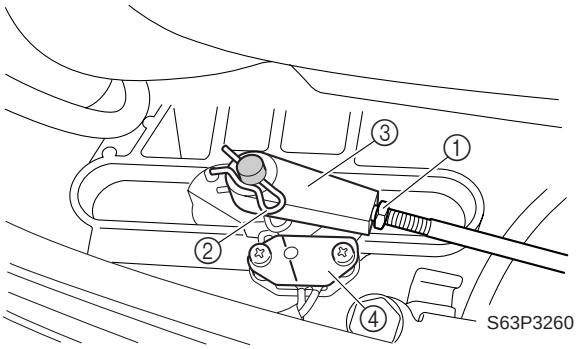
9. Check the throttle cable for smooth operation and, if necessary, repeat steps 1–8.

Checking the gear shift operation

1. Check that the gear shift operates smoothly when shifting it from neutral to forward or reverse. Adjust the shift cable length if necessary.

2. Set the gear shift to the neutral position.

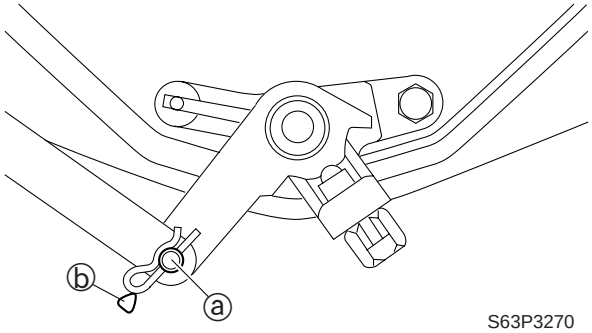
3. Loosen the locknut ①, remove the clip ②, and then disconnect the shift cable joint ③.



S63P3260

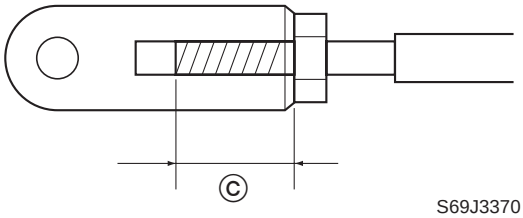
4. Adjust the position of the shift lever until the pin on the lever is aligned with the line on the shift position switch plate ④.

5. Align the center of the set pin ⓐ with the alignment mark ⓑ on the bottom cowling.



S63P3270

6. Adjust the position of the shift cable joint until its hole is aligned with the set pin.



S69J3370

CAUTION:

The shift cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⓒ.

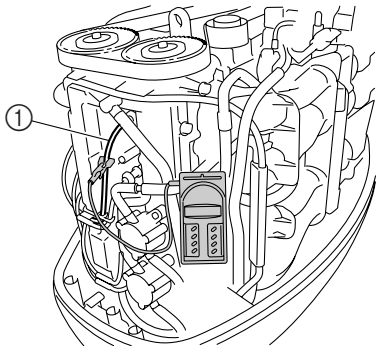
7. Connect the cable joint, install the clip, and then tighten the locknut.

8. Check the gear shift for smooth operation and, if necessary, repeat steps 3–7.

Checking the ignition timing

1. Start the engine and warm it up for 5 minutes.

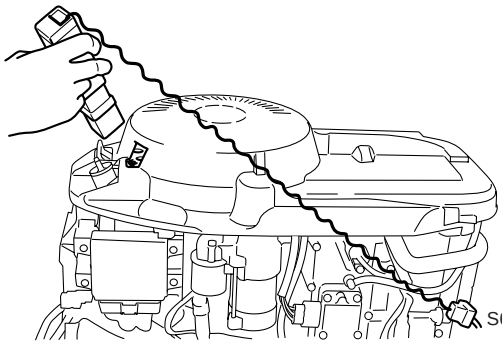
2. Attach the special service tool to spark plug wire #1 ①, and then check the engine idle speed.



S63P3140

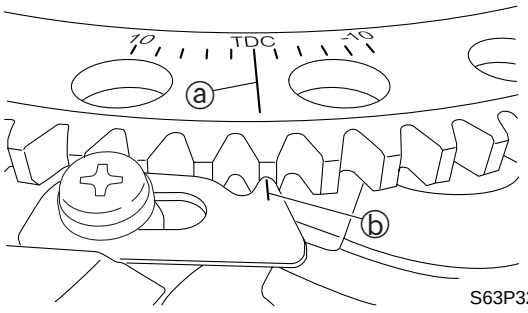
Digital tachometer: 90890-06760

3. Attach the special service tool to spark plug wire #1.


S63P3280

Timing light: 90890-03141

4. Check that the “TDC” mark ⓐ on the flywheel magnet is aligned with the mark ⓑ on the pointer.



S63P3290

Ignition timing at engine idle speed:
TDC

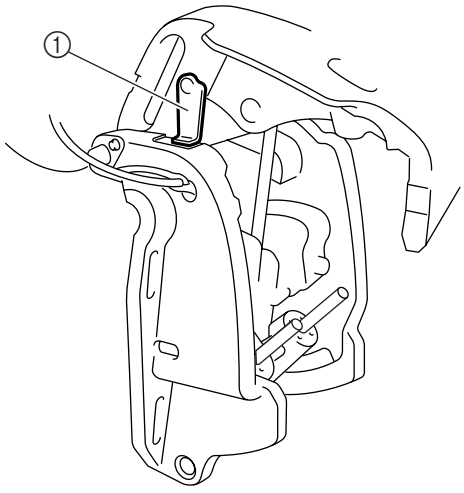
Power trim and tilt unit

Checking the power trim and tilt operation

1. Fully tilt the outboard motor up and down a few times and check the entire trim and tilt range for smooth operation. Check the power trim and tilt fluid level if necessary.

NOTE:
Be sure to listen to the winding sound of the power trim and tilt motor for smooth operation.

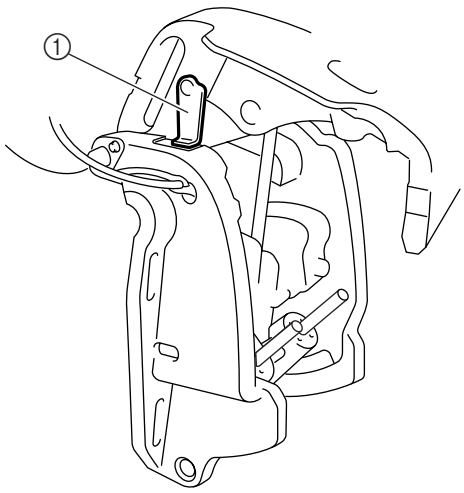
2. Fully tilt the outboard motor up, and then support it with the tilt stop lever ① to check the lock mechanism of the lever.



S60X3020

Checking the power trim and tilt fluid level

1. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.

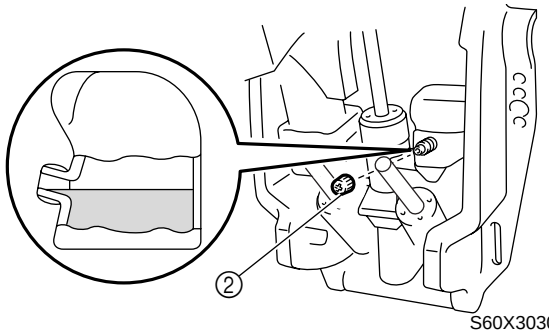


S60X3020

⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

2. Remove the reservoir cap ②, and then check the fluid level in the reservoir.



S60X3030

NOTE:
If the fluid is at the correct level, the fluid should overflow out of the filler hole when the reservoir cap is removed.

3. If necessary, add sufficient fluid of the recommended type until it overflows out of the filler hole.

Recommended power trim and tilt fluid:
ATF Dexron II

4. Install the reservoir cap, and then tighten it to the specified torque.

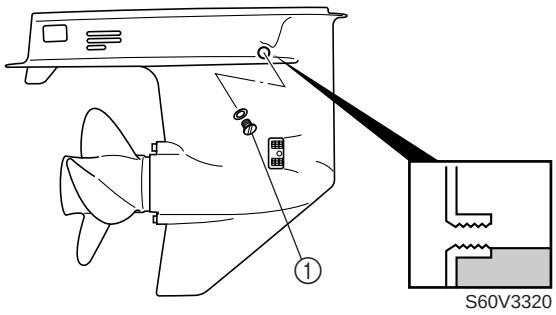
Reservoir cap:
0.7 N·m (0.07 kgf·m, 0.5 ft·lb)

Lower unit

Checking the gear oil level

1. Fully tilt the outboard motor down.

2. Remove the check screw ①, and then check the gear oil level in the lower case.



NOTE:
If the oil is at the correct level, the oil should overflow out of the check hole when the check screw is removed.

3. If necessary, add sufficient gear oil of the recommended type until it overflows out of the check hole.

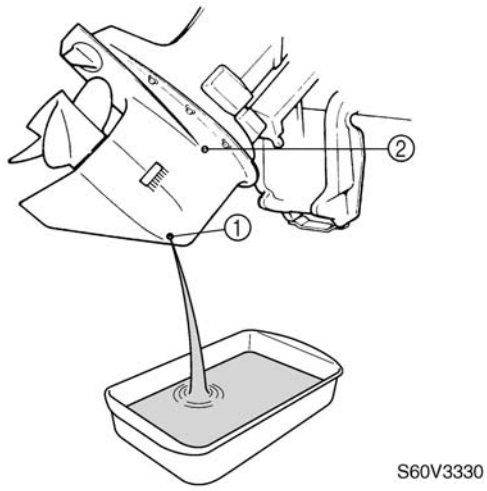
Recommended gear oil:
Hypoid gear oil
SAE: 90

4. Install the check screw.

Changing the gear oil

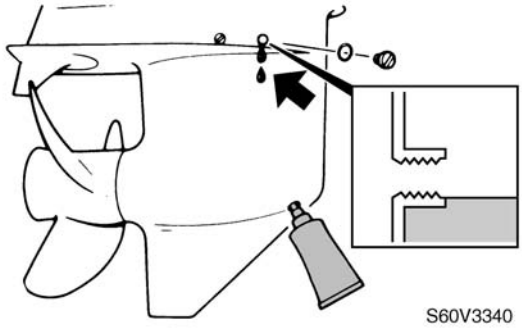
1. Tilt the outboard motor up slightly.

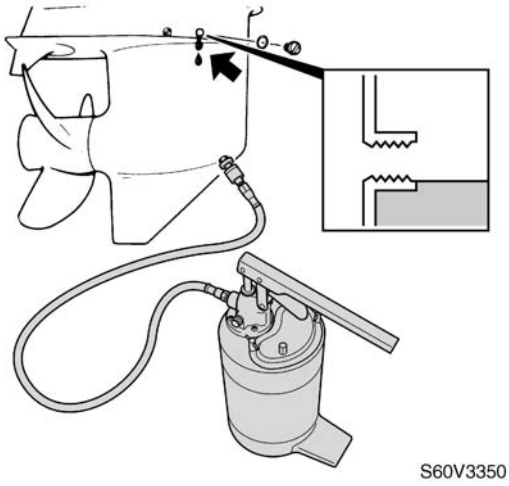
2. Place a drain pan under the drain screw ①, remove the drain screw, then the check screw ② and let the oil drain completely.



3. Check the oil for metal and discoloration, and its viscosity. Check the internal parts of the lower case if necessary.

4. Insert a gear oil tube or gear oil pump into the drain hole and slowly fill the gear oil until oil flows out of the check hole and no air bubbles are visible.



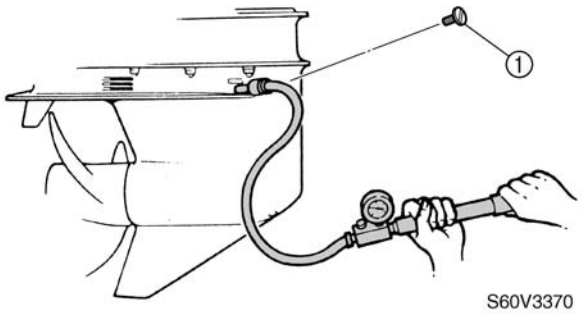


Recommended gear oil:
Hypoid gear oil
SAE: 90
Oil quantity:
Regular rotation model:
980 cm^3
(33.1 US oz, 34.6 Imp oz)
Counter rotation model:
870 cm^3
(29.4 US oz, 30.7 Imp oz)

5. Install the check screw and quickly install the drain screw.

Checking the lower unit for air leakage

1. Remove the check screw ①, and then install the special service tool.



S60V3370

Leakage tester: 90890-06840

2. Apply the specified pressure to check that the pressure is maintained in the lower unit for at least 10 seconds.

CAUTION:

Do not over pressurize the lower unit, otherwise the oil seals can be damaged.

NOTE:

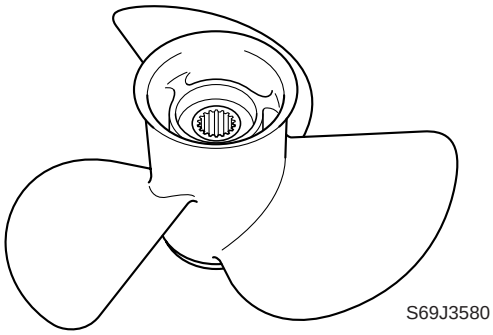
Cover the check hole with a rag when removing the tester from the lower unit.

Lower unit holding pressure:
70 kPa (0.7 kgf/cm^2, 10 psi)

3. If pressure drops below specification, check the drive shaft and propeller shaft oil seals for damage.

Checking the propeller

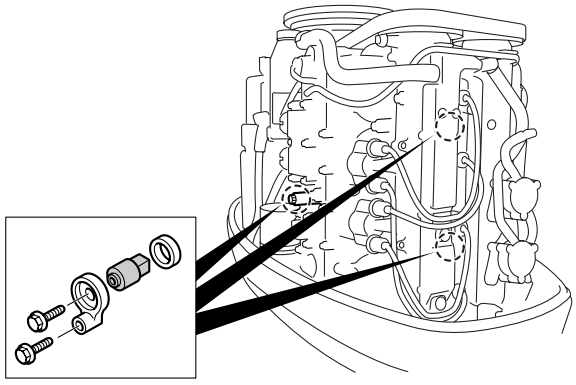
1. Check the propeller blades and splines for cracks, damage, or wear. Replace if necessary.

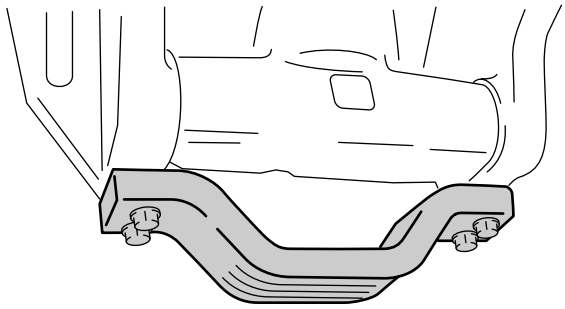

S69J3580

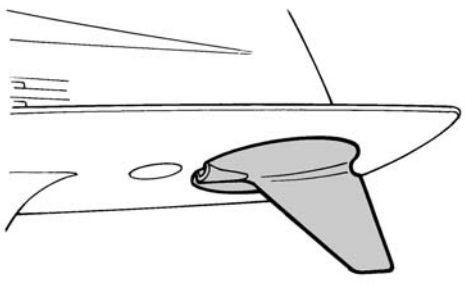
General

Checking the anodes

1. Check the anodes and trim tab for scales, grease, or oil. Clean if necessary.


S63P3300


S60X3080


S69J3610

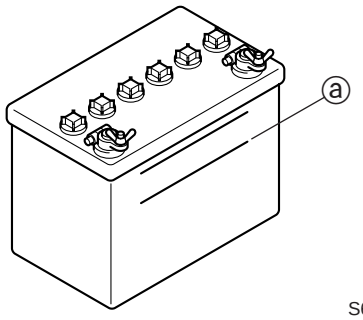
CAUTION:

Do not oil, grease, or paint the anodes or the trim tab, otherwise they will be ineffective.

2. Replace the anodes or trim tab if excessively eroded.

Checking the battery

1. Check the battery electrolyte level. If the level is at or below the minimum level mark ⓐ, add distilled water until the level is between the maximum and minimum level marks.



S69J3620

2. Check the specific gravity of the electrolyte. Fully charge the battery if out of specification.

⚠ WARNING

Battery electrolyte is dangerous; it contains sulfuric acid which is poisonous and highly caustic.
Always follow these preventive measures:
- **Avoid bodily contact with electrolyte as it can cause severe burns or permanent eye injury.**
- **Wear protective eye gear when handling or working near batteries.**

Antidote (EXTERNAL):
- **SKIN – Wash with water.**
- **EYES – Flush with water for 15 minutes and get immediate medical attention.**

Antidote (INTERNAL):
- **Drink large quantities of water or milk followed with milk of magnesia, beaten egg, or vegetable oil. Get immediate medical attention.**

Batteries generate explosive, hydrogen gas. Always follow these preventive measures:
- **Charge batteries in a well-ventilated area.**
- **Keep batteries away from fire, sparks or open flames (e.g., welding equipment, lighted cigarettes).**
- **DO NOT SMOKE when charging or handling batteries.**

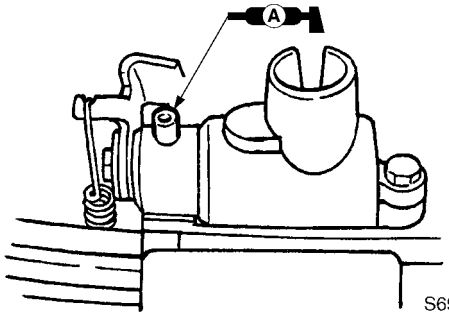
KEEP BATTERIES AND ELECTROLYTE OUT OF REACH OF CHILDREN.

NOTE:
- Batteries vary per manufacturer. The procedures mentioned in this manual may not always apply, therefore, consult the instruction manual of the battery.
- Disconnect the negative battery lead first, then the positive battery lead.

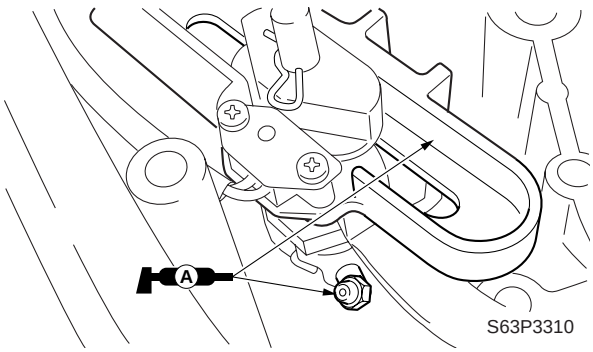
Electrolyte specific gravity:
1.280 at 20 °C (68 °F)

Lubricating the outboard motor

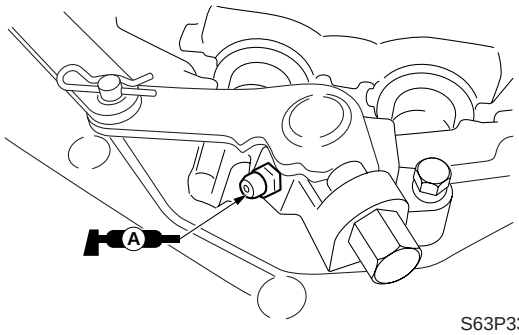
1. Apply water resistant grease to the areas shown.



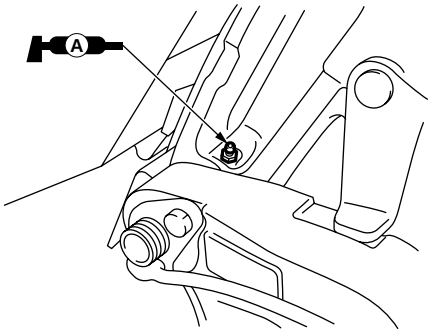
S69J3630



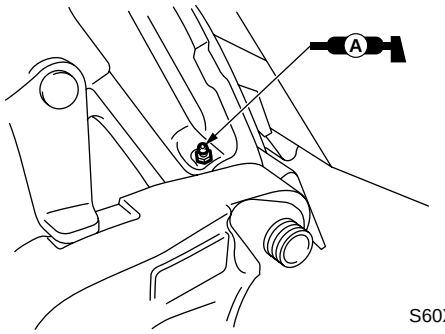
S63P3310



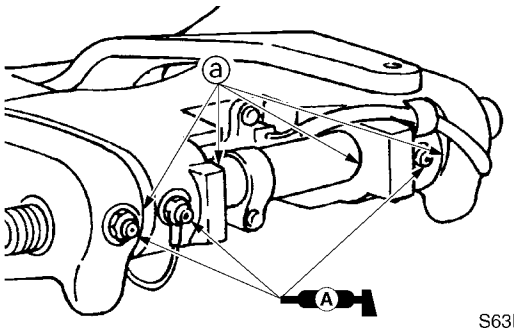
S63P3320



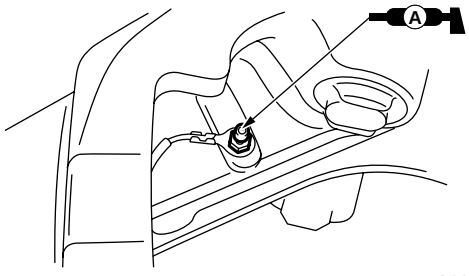
S60X3090



S60X3100



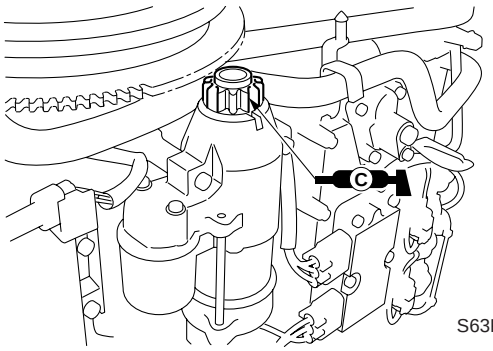
S63P3330



S60X3120

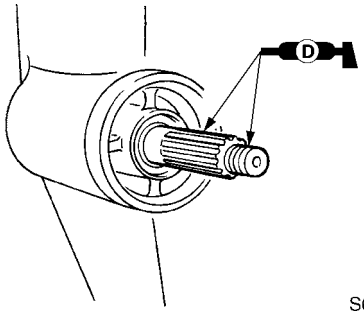
NOTE:
Apply grease to the grease nipple until it flows from the bushings ⓐ.

2. Apply low temperature resistant grease to the areas shown.



S63P3340

3. Apply corrosion resistant grease to the areas shown.



S69J3720

Fuel system

Special service tools 4-1

Hose routing 4-2
Fuel and blowby hoses 4-2

Fuel filter, fuel pump, and intake silencer 4-3
Checking the fuel pumps 4-7
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Checking the diaphragm and valves 4-8
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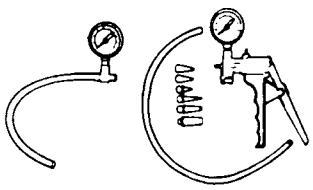
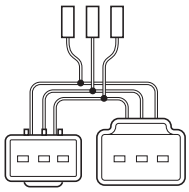
Intake assembly and vapor separator 4-9
Measuring the fuel pressure 4-13
Checking the pressure regulator 4-13
Checking the check valve 4-14
Reducing the fuel pressure 4-15
Checking the vapor separator 4-15
Synchronizing the throttle valves 4-16
Adjusting the throttle position sensor 4-17
Adjusting the throttle position sensor
(when disassembling or replacing the throttle body) 4-18

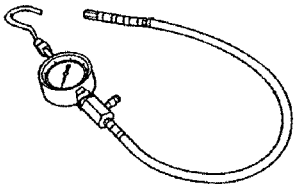
Special service tools



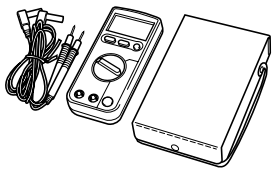
Vacuum/pressure pump gauge set
90890-06756



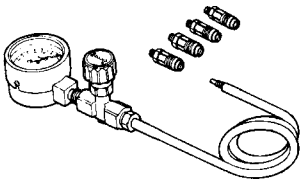
Test harness (3 pins)
90890-06793



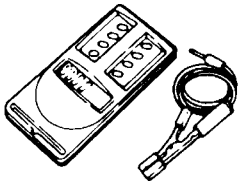
Fuel pressure gauge
90890-06786



Digital circuit tester
90890-03174



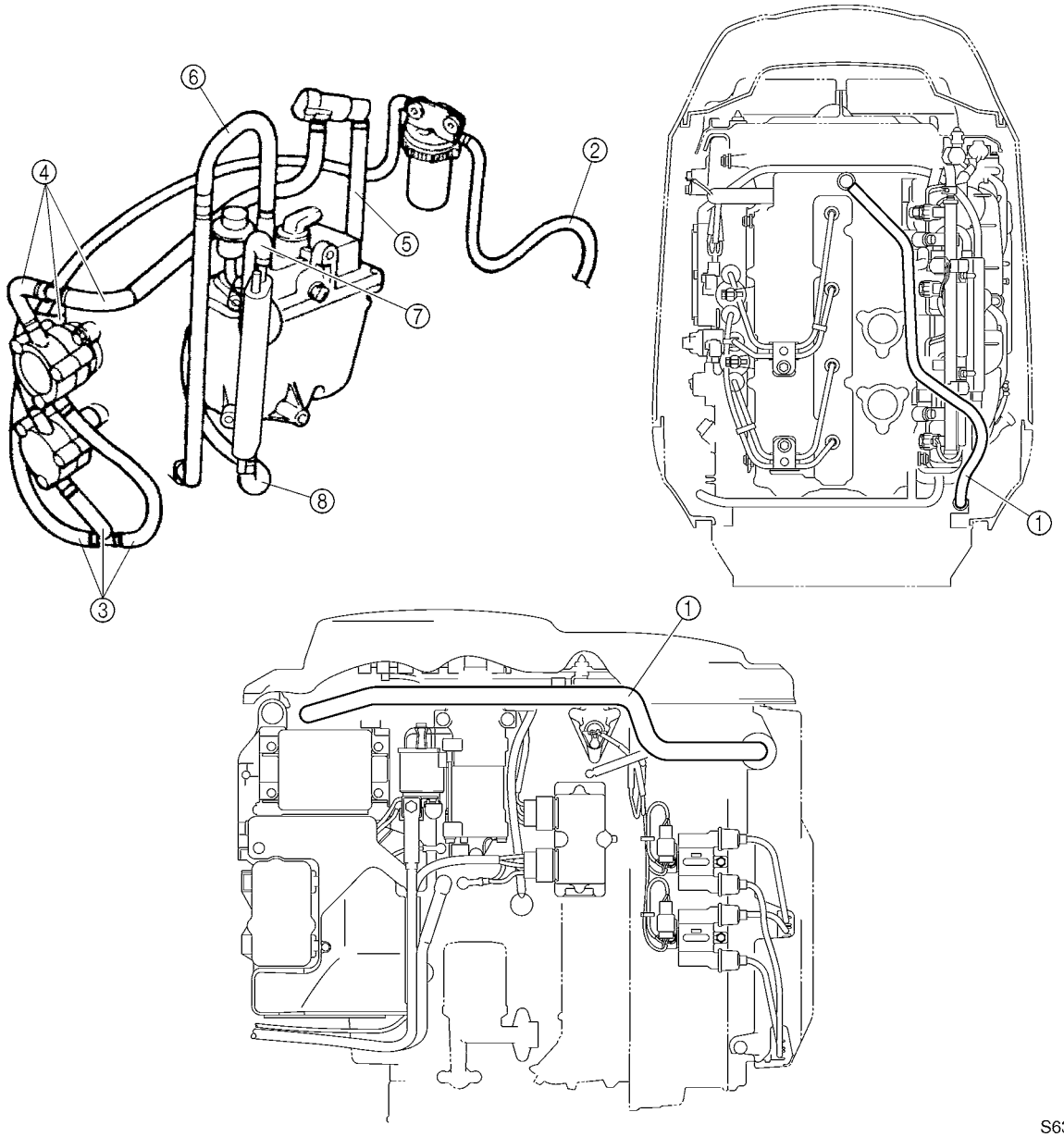
Vacuum gauge
90890-03159



Digital tachometer
90890-06760

Hose routing

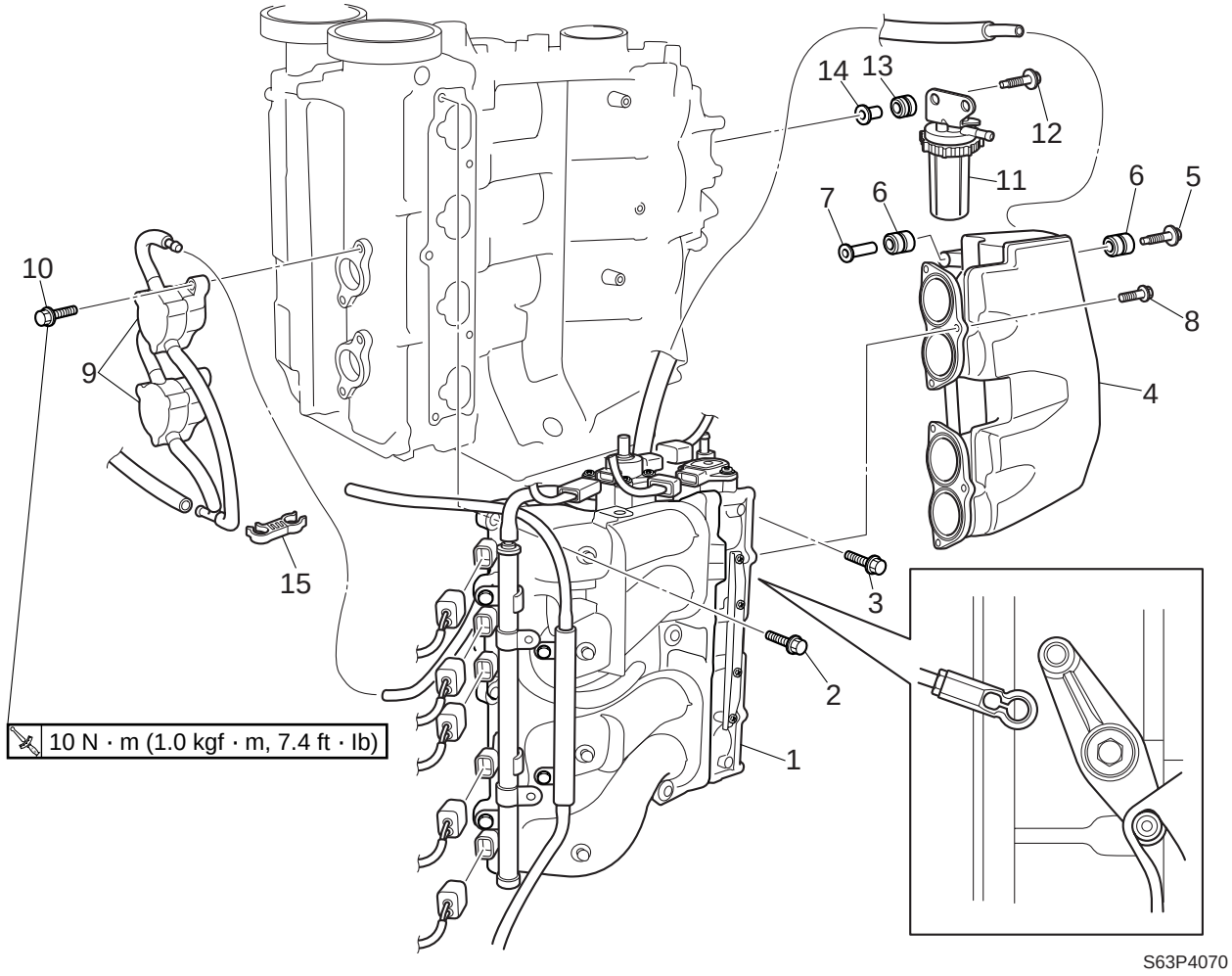
Fuel and blowby hoses



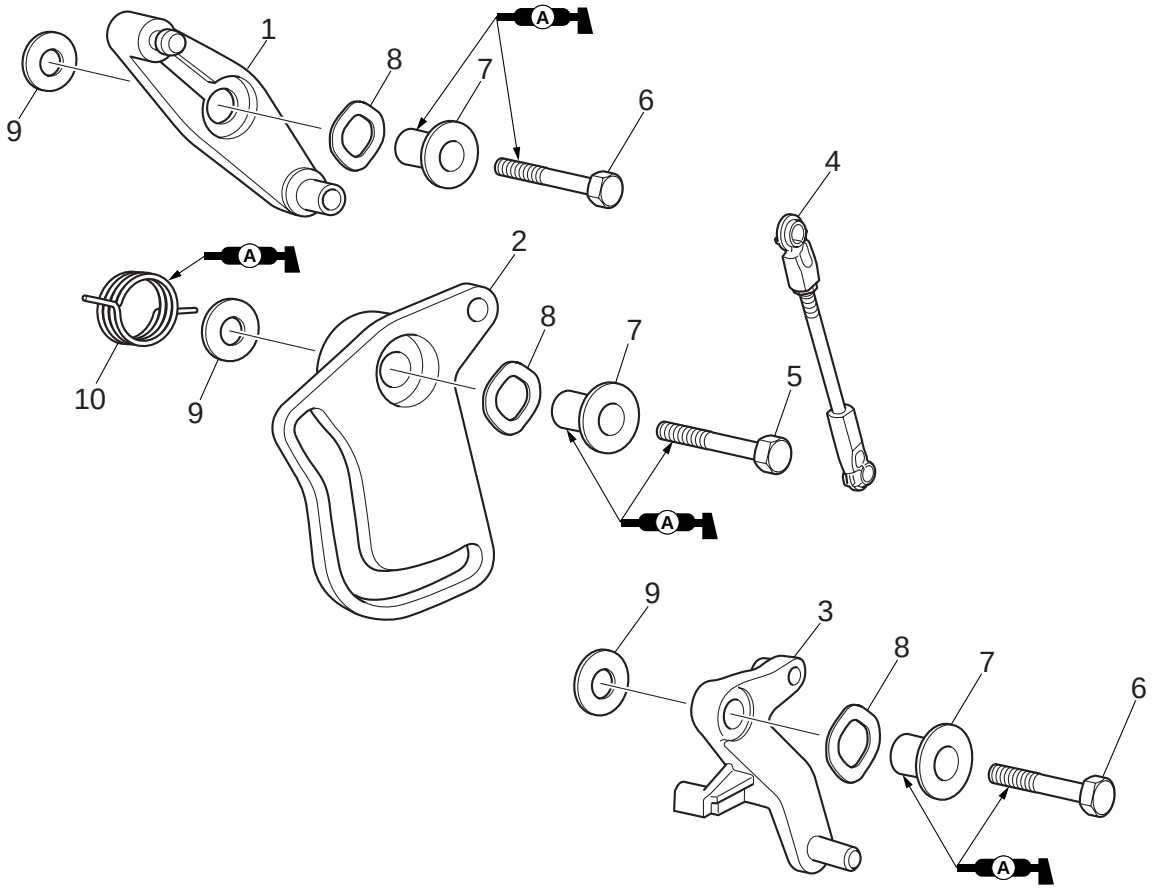
S63P4060

① Blowby hoses
② Fuel hose (fuel tank-to-fuel filter)
③ Fuel hoses (fuel filter-to-fuel pumps)
④ Fuel hoses (fuel pumps-to-fuel filter)
⑤ Fuel hose (fuel filter-to-vapor separator)
⑥ High-pressure fuel hose (vapor separator-to-fuel rail)
⑦ Fuel hose (pressure regulator-to-fuel cooler)
⑧ Fuel hose (fuel cooler-to-vapor separator)

Fuel filter, fuel pump, and intake silencer

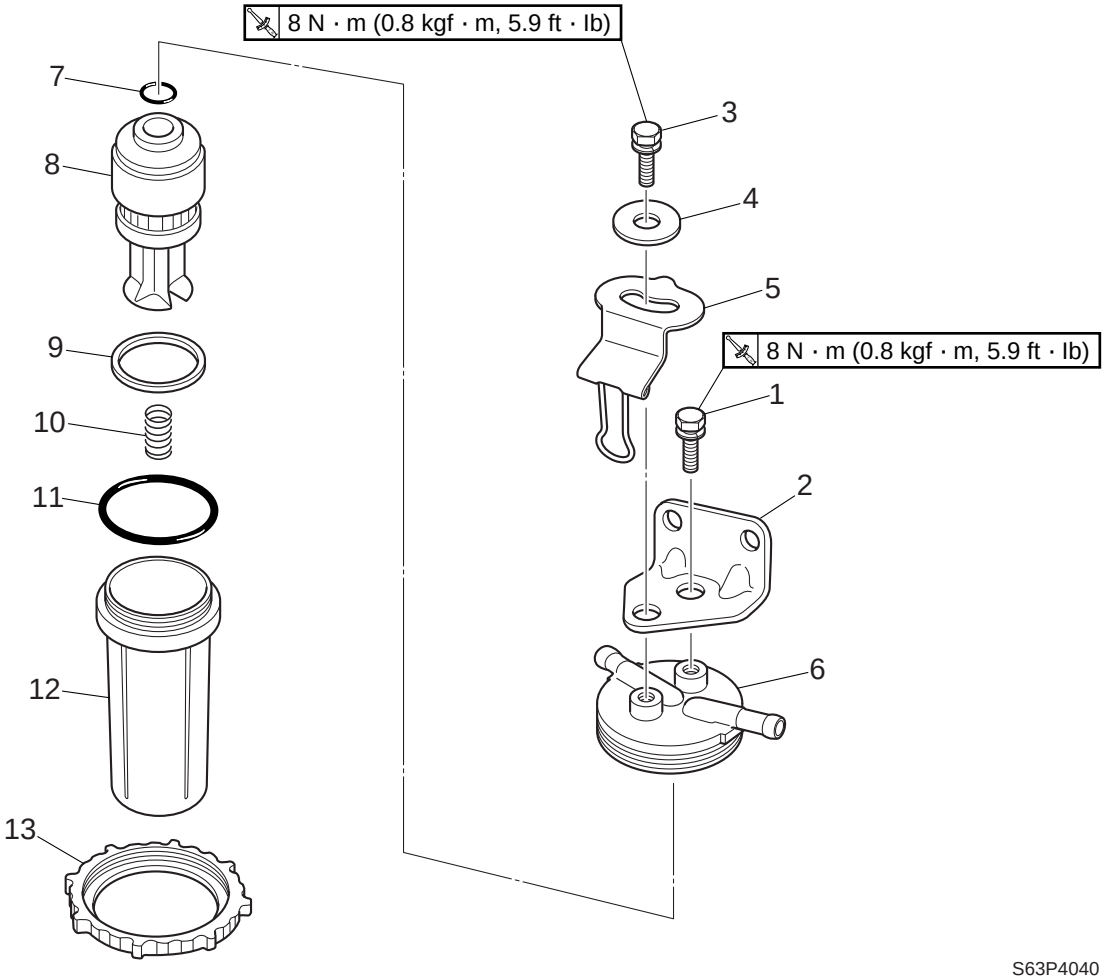


No.	Part name	Q'ty	Remarks
1	Intake assembly	1	
2	Bolt	5	M8 × 40 mm
3	Bolt	2	M8 × 20 mm
4	Intake silencer	1	
5	Bolt	2	M6 × 45 mm
6	Grommet	4	
7	Collar	2	
8	Bolt	6	M6 × 20 mm
9	Fuel pump	2	
10	Bolt	4	M6 × 30 mm
11	Fuel filter	1	
12	Bolt	2	M6 × 30 mm
13	Grommet	2	
14	Collar	2	
15	Holder	1	



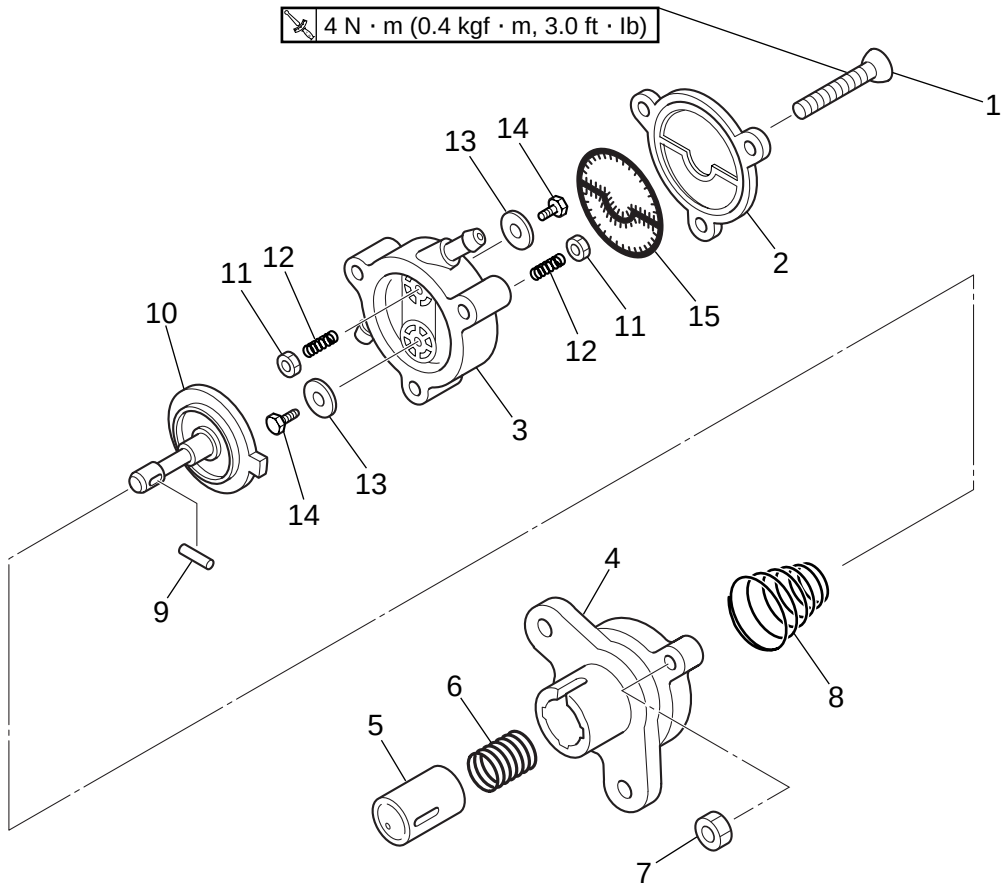
S63P4080

No.	Part name	Q'ty	Remarks
1	Throttle lever 1	1	
2	Throttle cam	1	
3	Throttle lever 2	1	
4	Throttle link rod	1	
5	Bolt	1	M6 × 35 mm
6	Bolt	2	M6 × 25 mm
7	Collar	3	
8	Wave washer	3	
9	Washer	3	
10	Spring	1	



S63P4040

No.	Part name	Q'ty	Remarks
1	Bolt	1	M6 × 14 mm
2	Bracket	1	
3	Bolt	1	M6 × 16 mm
4	Washer	1	
5	Holder	1	
6	Cap	1	
7	O-ring	1	**Not reusable**
8	Fuel filter element	1	
9	Float	1	
10	Spring	1	
11	O-ring	1	**Not reusable**
12	Cup	1	
13	Nut	1	



S63P4050

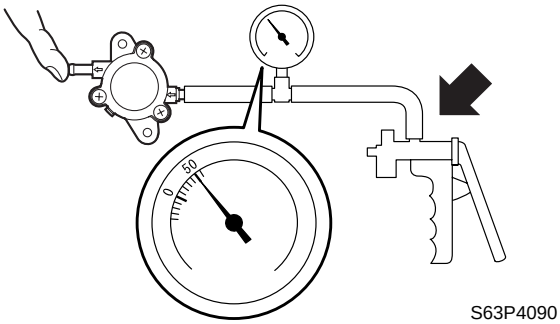
No.	Part name	Q'ty	Remarks
1	Screw	3	ø6 × 35 mm
2	Cover	1	
3	Fuel pump body 2	1	
4	Fuel pump body 1	1	
5	Plunger	1	
6	Spring	1	
7	Nut	3	
8	Spring	1	
9	Pin	1	
10	Diaphragm	1	
11	Nut	2	
12	Spring	2	
13	Valve	2	
14	Screw	2	
15	Gasket	1	**Not reusable**

Checking the fuel pumps

1. Place a drain pan under the fuel hose connections, and then disconnect the fuel hoses from the fuel pumps.

2. Connect the special service tool to the fuel pump inlet.

3. Cover the fuel pump outlet with a finger, and then apply the specified positive pressure. Check that there is no air leakage.

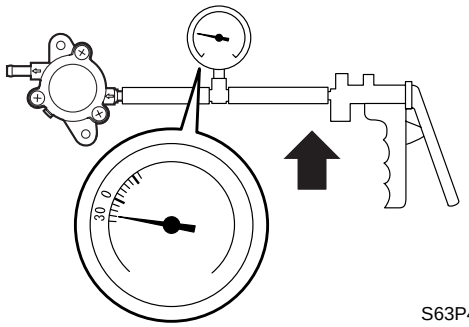


S63P4090

Vacuum/pressure pump gauge set:
90890-06756

Specified pressure:
50 kPa (0.5 kgf/cm^2, 7.3 psi)

4. Apply the specified negative pressure and check that there is no air leakage.

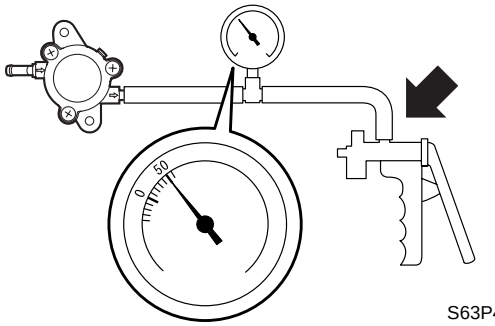


S63P4100

Specified pressure:
30 kPa (0.3 kgf/cm^2, 4.4 psi)

5. Connect the special service tool to the fuel pump outlet.

6. Apply the specified positive pressure and check that there is no air leakage. Disassemble the fuel pump if necessary.



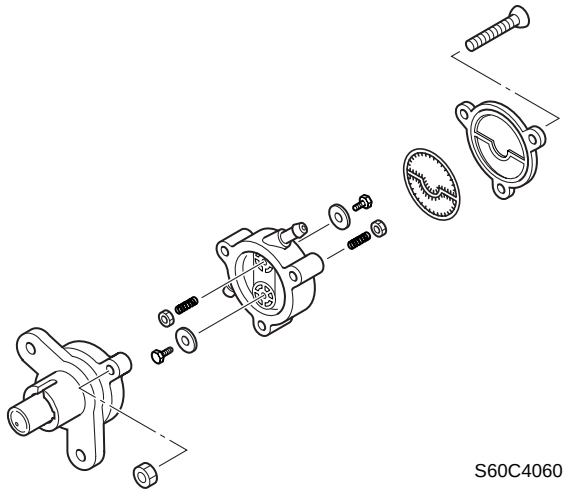
S63P4110

Specified pressure:
50 kPa (0.5 kgf/cm^2, 7.3 psi)

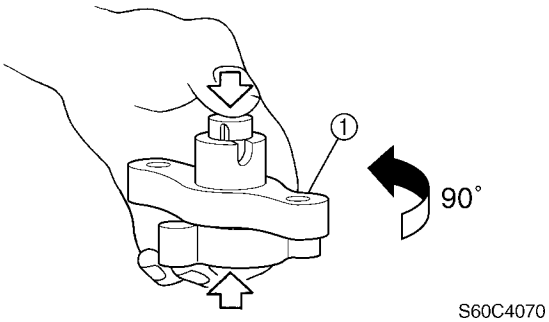
NOTE:
Assemble the fuel pump valve to the fuel pump body, and moisten the inside of the fuel pump with gasoline to ensure a good seal.

Disassembling a fuel pump

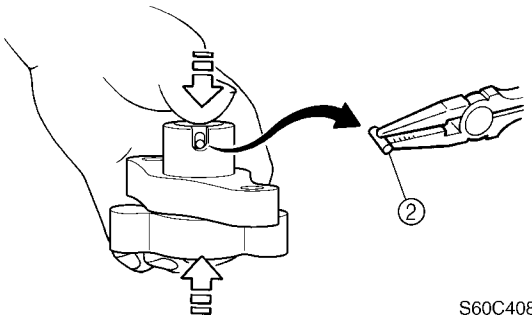
1. Disassemble the fuel pump as shown.


S60C4060

2. Push down on the plunger and the diaphragm, turn fuel pump body 1 ① approximately 90° to a position where the pin ② can be removed easily, and then remove the pin.



S60C4070

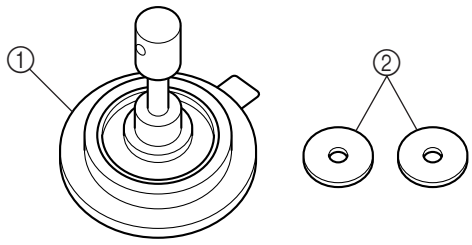


S60C4080

3. Slowly let up on the plunger and diaphragm, and then remove them.

Checking the diaphragm and valves

1. Check the diaphragm ① for tears and the valves ② for cracks. Replace if necessary.



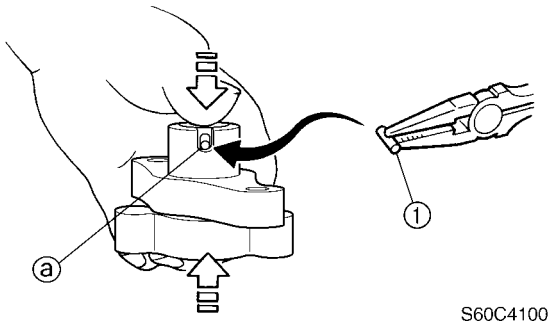
S60C4090

Assembling a fuel pump

NOTE:
Clean the parts and soak the valves and the diaphragm in gasoline before assembly to obtain prompt operation of the fuel pumps when starting the engine.

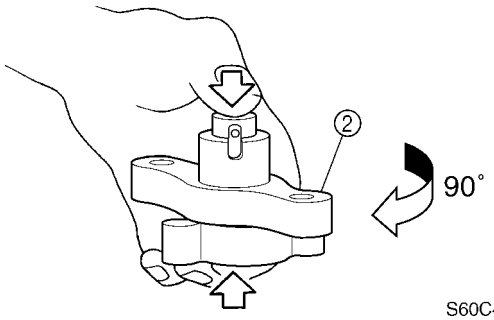
1. Align the plunger and diaphragm installation holes ⓐ, and then install the plunger into the diaphragm.

2. Push down on the plunger and the diaphragm, and then install the pin ①.



S60C4100

3. Turn fuel pump body 1 ② approximately 90°, and then push down on the plunger several times to make sure that the pin does not come out.

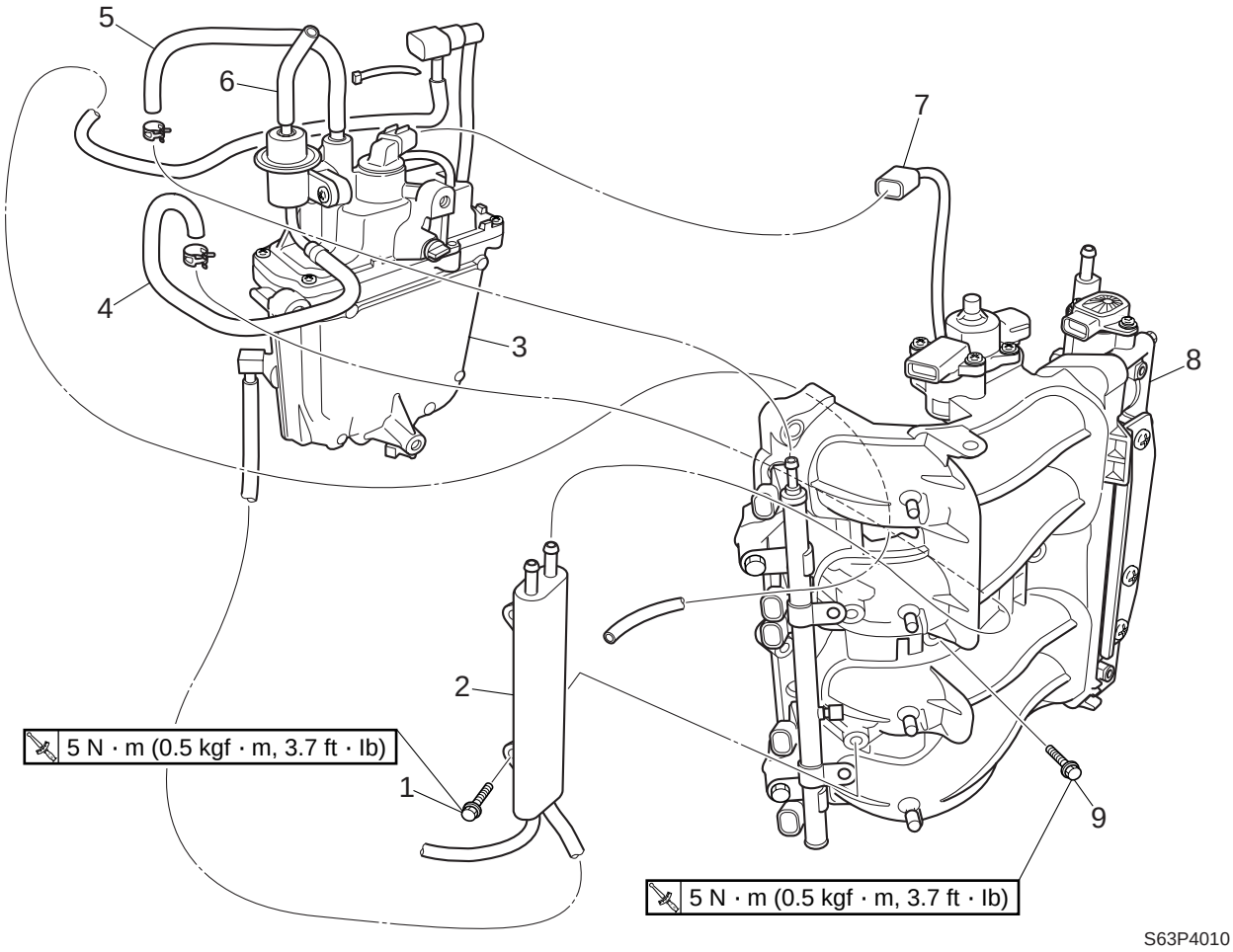


S60C4110

NOTE:
Make sure that the gasket and diaphragm are kept in place through the assembly process.

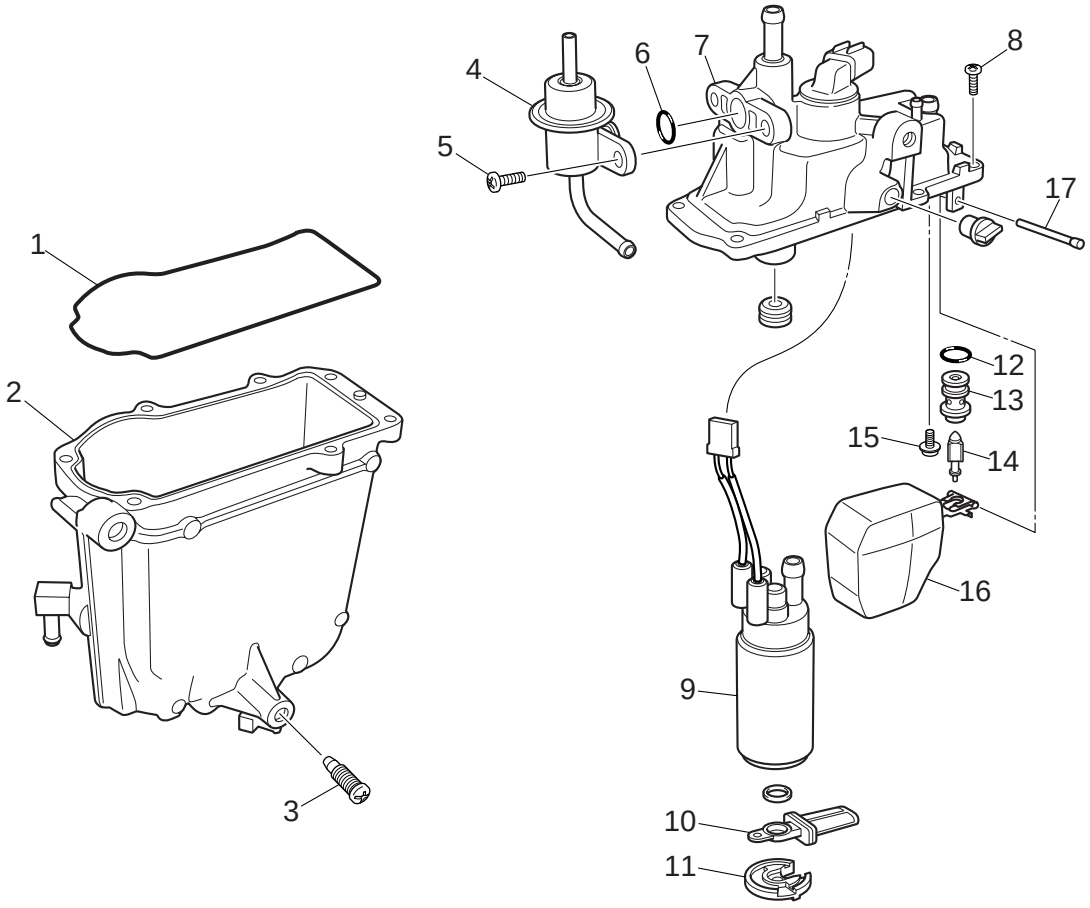
4

Intake assembly and vapor separator



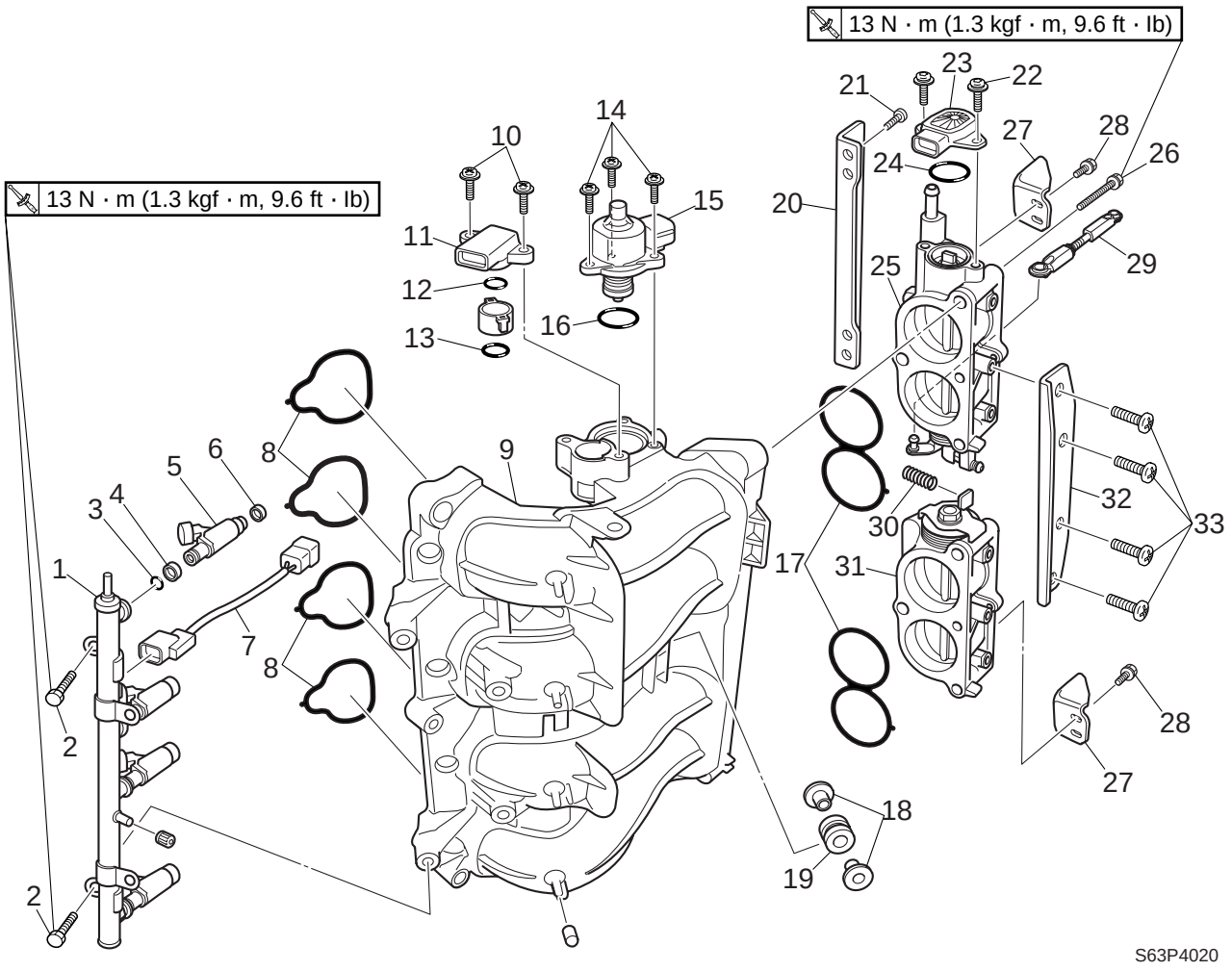
S63P4010

No.	Part name	Q'ty	Remarks
1	Bolt	2	M6 × 25 mm
2	Fuel cooler	1	
3	Vapor separator	1	
4	Fuel hose	1	
5	Fuel hose	1	
6	Hose	1	
7	Electric fuel pump coupler	1	
8	Intake assembly	1	
9	Bolt	3	M6 × 35 mm

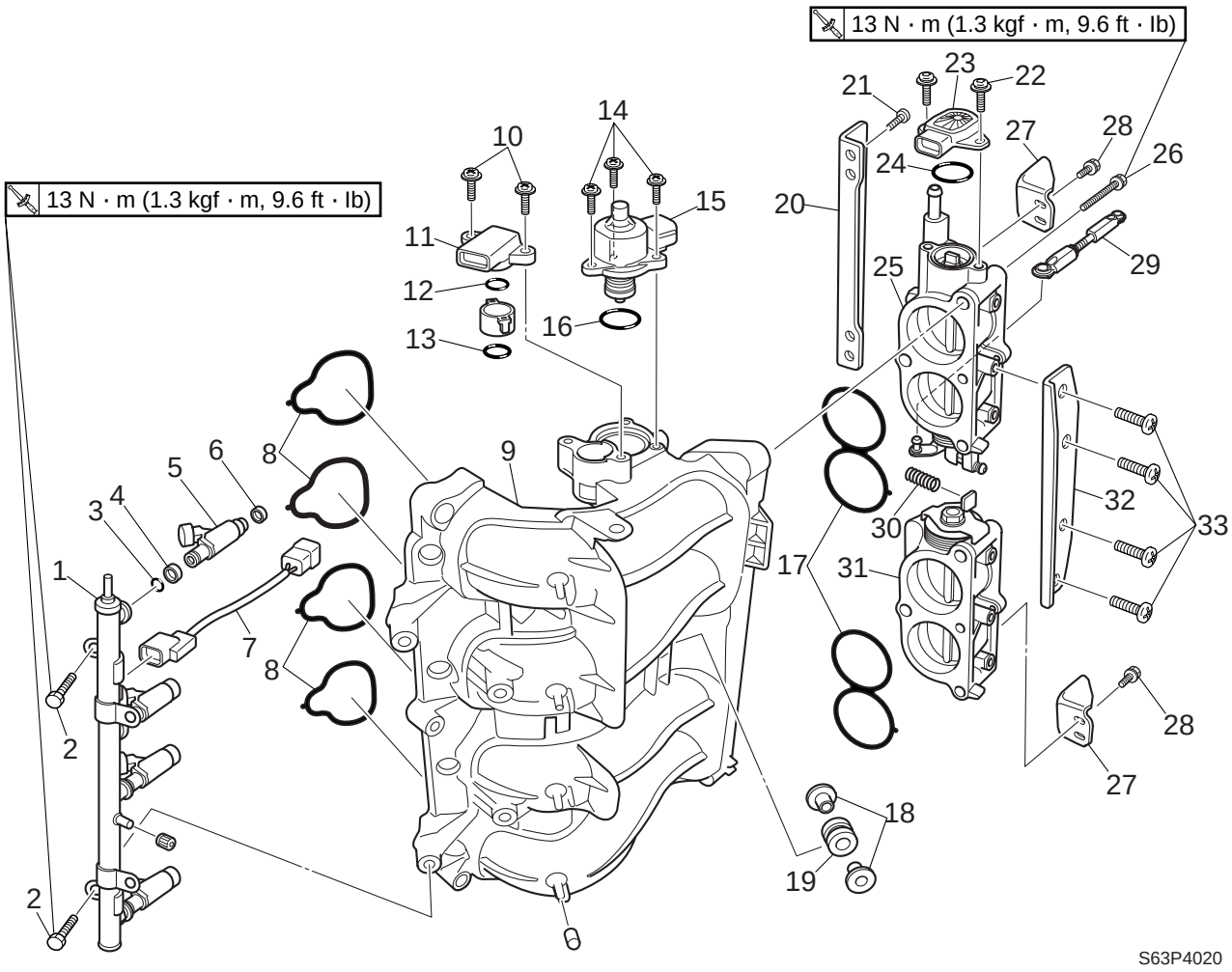


S63P4030

No.	Part name	Q'ty	Remarks
1	O-ring	1	**Not reusable**
2	Float chamber	1	
3	Drain screw	1	
4	Pressure regulator	1	
5	Screw	2	M6 × 12 mm
6	O-ring	1	**Not reusable**
7	Cover	1	
8	Screw	7	ø4 × 16 mm
9	Electric fuel pump	1	
10	Filter	1	
11	Filter holder	1	
12	O-ring	1	**Not reusable**
13	Collar	1	
14	Needle valve	1	
15	Screw	1	ø4 × 8 mm
16	Float	1	
17	Pin	1	



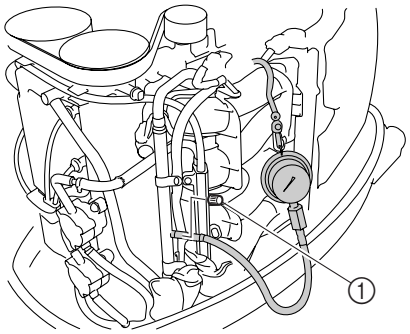
No.	Part name	Q'ty	Remarks
1	Fuel rail	1	
2	Bolt	2	M8 × 25 mm
3	O-ring	4	**Not reusable**
4	Rubber damper	4	**Not reusable**
5	Fuel injector	4	
6	Rubber seal	4	**Not reusable**
7	Electric fuel pump lead	1	
8	Gasket	4	**Not reusable**
9	Intake manifold	1	
10	Screw	2	ø5 × 15 mm
11	Intake air pressure sensor	1	
12	O-ring	1	**Not reusable**
13	O-ring	1	**Not reusable**
14	Screw	3	ø4 × 15 mm
15	Idle speed control	1	
16	O-ring	1	**Not reusable**
17	Gasket	2	**Not reusable**



No.	Part name	Q'ty	Remarks
18	Collar	6	
19	Grommet	3	
20	Bracket	1	
21	Screw	4	ø6 × 16 mm
22	Screw	2	ø4 × 12 mm
23	Throttle position sensor	1	
24	O-ring	1	**Not reusable**
25	Throttle body #1	1	
26	Bolt	6	M8 × 70 mm
27	Bracket	2	
28	Screw	4	ø6 × 16 mm
29	Throttle joint link rod	1	
30	Spring	1	
31	Throttle body #2	1	
32	Bracket	1	
33	Screw	4	ø6 × 16 mm

Measuring the fuel pressure

1. Remove the cap ①.
2. Connect the fuel pressure gauge to the pressure check valve.



S63P4130

Fuel pressure gauge: 90890-06786

⚠ WARNING

- **When connecting the fuel pressure gauge, first cover the connection between the gauge and the pressure check valve with a clean, dry rag to prevent fuel from leaking out.**
- **Gently screw in the gauge until it is firmly connected.**

3. Turn the engine start switch to ON, and then measure the fuel pressure within 3 seconds.

NOTE:
The fuel pressure decreases 3 seconds after the engine start switch is turned to ON.

Fuel pressure (reference data):
310 kPa (3.1 kgf/cm^2, 45.0 psi)

4. Start the engine, warm it up for 5 minutes, and then measure the fuel pressure. If below specification, check the high-pressure fuel line and the vapor separator.

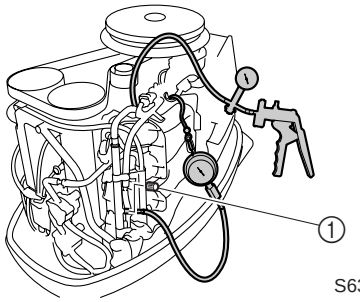
Fuel pressure (reference data):
260 kPa (2.6 kgf/cm^2, 37.7 psi)

⚠ WARNING

- **Before measuring the fuel pressure, make sure that the drain screw is tightened securely.**
- **Do not loosen the drain screw while measuring the fuel pressure. Loosening the drain screw can cause fuel to spray out creating a fire hazard.**
- **After measuring the fuel pressure, cover the end of the hose with a clean, dry rag, point the hose downward, and then loosen the drain screw to drain the remaining fuel from the hose and gauge.**
- **When storing the fuel pressure gauge, make sure that the drain screw is tightened securely.**

Checking the pressure regulator

1. Remove the cap ①.
2. Connect the fuel pressure gauge to the pressure check valve.
3. Disconnect the pressure regulator hose, and then connect the special service tools to the pressure regulator.



S63P4140

Fuel pressure gauge: 90890-06786
Vacuum/pressure pump gauge set:
90890-06756

⚠ WARNING

- **When connecting the fuel pressure gauge, first cover the connection between the gauge and the pressure check valve with a clean, dry rag to prevent fuel from leaking out.**
- **Gently screw in the gauge until it is firmly connected.**

4. Start the engine and let it idle.

5. Check that the fuel pressure reduces when vacuum pressure is applied to the pressure regulator. If the fuel pressure does not reduce, replace the pressure regulator.

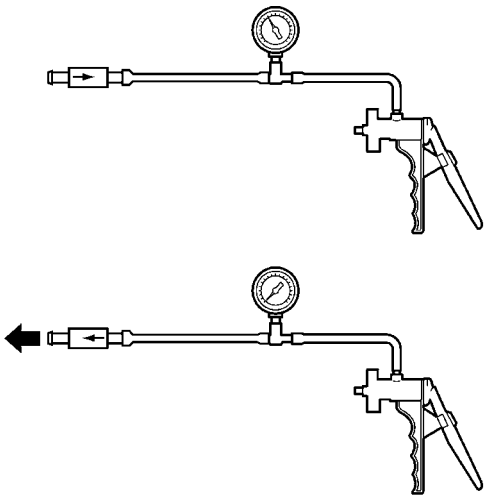
⚠ WARNING

- **Before measuring the fuel pressure, make sure that the drain screw is tightened securely.**
- **Do not loosen the drain screw while measuring the fuel pressure. Loosening the drain screw can cause fuel to spray out creating a fire hazard.**
- **After measuring the fuel pressure, cover the end of the hose with a clean, dry rag, point the hose downward, and then loosen the drain screw to drain the remaining fuel from the hose and gauge.**
- **When storing the fuel pressure gauge, make sure that the drain screw is tightened securely.**

Checking the check valve

1. Connect the special service tool to the check valve.

2. Apply pressure to each check valve port. Replace if necessary.



S60V4200

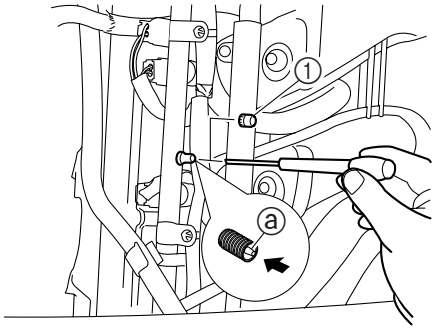
Vacuum/pressure pump gauge set: 90890-06756

NOTE:
Check that no air comes out of the opposite end of the check valve.

4

Reducing the fuel pressure

1. Remove the cap ①.
2. Cover the pressure check valve ⓐ of the fuel rail with a rag, and then press in the pressure check valve ⓐ using a thin screwdriver to release the fuel pressure.

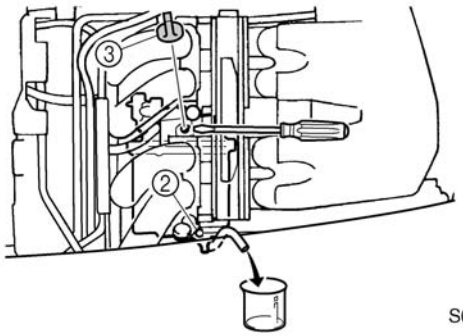


S63P4160

⚠ WARNING

Always reduce the fuel pressure in the high-pressure fuel line before servicing the line or the vapor separator. If the fuel pressure is not released, pressurized fuel may spray out.

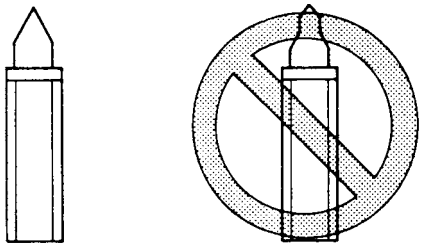
3. Place a container under the vapor separator drain hose, and then loosen the drain screw ②.
4. Remove the cap ③.
5. Drain the fuel from the vapor separator drain hose by pressing the valve using a thin screwdriver.



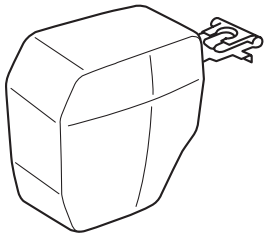
S63P4170

Checking the vapor separator

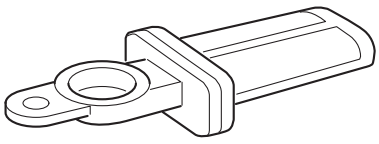
1. Check the needle valve for bends or wear. Replace if necessary.


S69J4080

2. Check the float for deterioration. Replace if necessary.


S63P4180

3. Check the filter for dirt or residue. Clean if necessary.

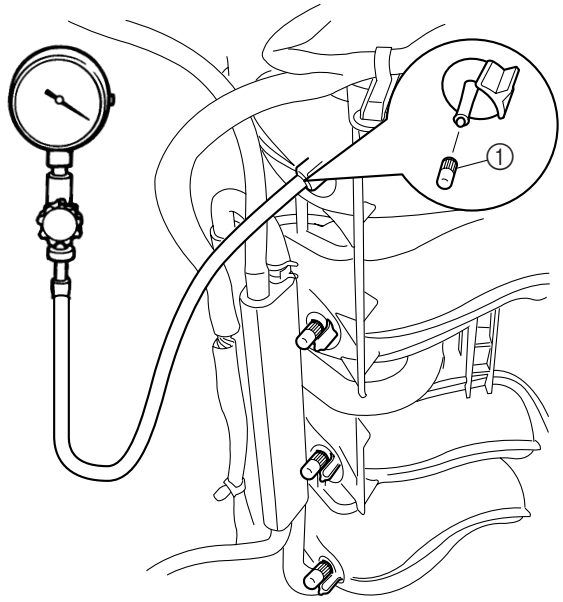

S63P4190

Synchronizing the throttle valves

CAUTION:

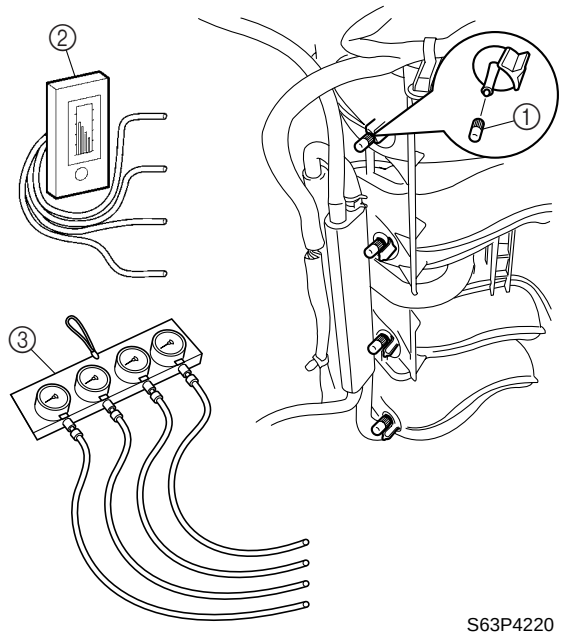
Do not adjust the throttle valve when it is operating properly. Excess adjustment may cause poor engine performance.

1. Remove the caps ①, and then attach the special service tool to the intake manifold as shown.



S63P4210

	Vacuum gauge: 90890-03159

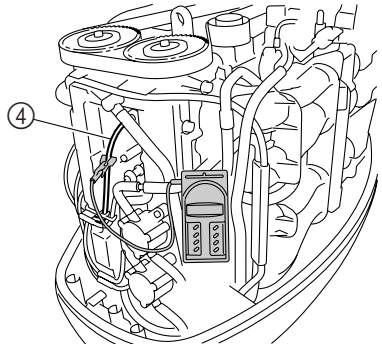


S63P4220

NOTE:

For best results, use a vacuum gauge (commercially available), like ② or ③ shown in the illustration, that has four adapters.

2. Start the engine and warm it up for 5 minutes.
3. Attach the special service tool to spark plug wire #1 ④, and then check the engine idle speed.



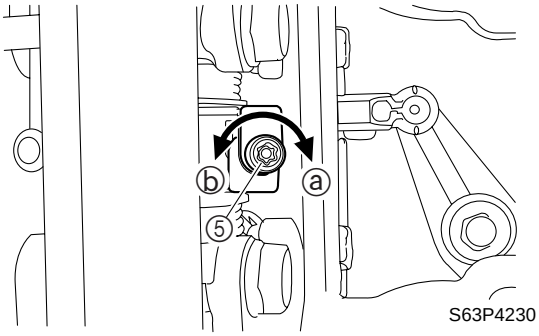
S63P4250

	Digital tachometer: 90890-06760

	Engine idle speed: 700 ± 50 r/min

4. Check the vacuum pressure of all cylinders.

5. Turn the synchronizing screw ⑤ so that the vacuum pressure of cylinder #3 or #4 is within 2 kPa (15 mmHg) based on the vacuum pressure of cylinder #1 or #2.



Direction ⓐ	Vacuum pressure is increase.
Direction ⓑ	Vacuum pressure is decrease.

Example
Check results:

Cylinder	#1	#2	#3	#4
kPa (mmHg)	49 (370)	48 (360)	47 (350)	46 (340)

Adjust the difference of the vacuum pressure between cylinders #1 and #4 within 2 kPa (15 mmHg).

Check results:

Cylinder	#1	#2	#3	#4
kPa (mmHg)	49 (370)	48 (360)	50 (370)	51 (380)

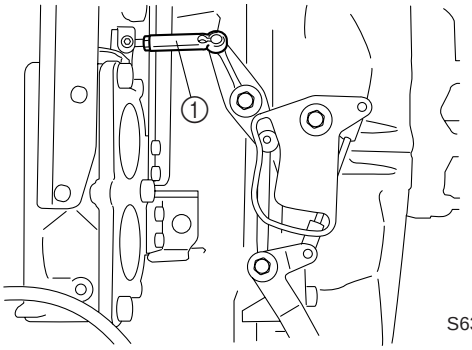
Adjust the difference of the vacuum pressure between cylinders #2 and #4 within 2 kPa (15 mmHg).

Adjusting the throttle position sensor

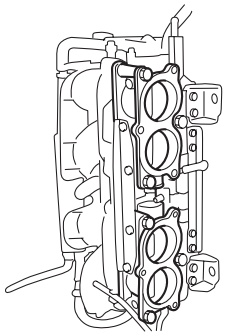
NOTE:
- Be sure to adjust the throttle valve's opening before measuring the throttle position sensor output voltage.
- When measuring the throttle position sensor output voltage, set the digital tester to the manual range.

1. Remove the intake silencer.

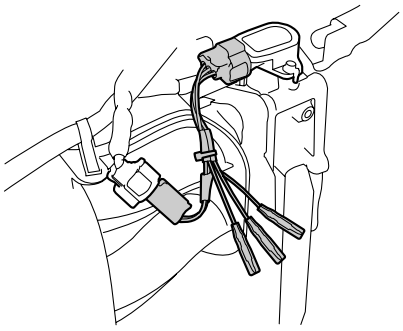
2. Disconnect the throttle joint link rod ① from the throttle lever 1.



3. Check that the throttle valves are in the fully closed position.



4. Connect the test harness (3 pins) to the throttle position sensor.



Test harness (3 pins): 90890-06793

5. Turn the engine start switch to ON.

6. Measure the throttle position sensor output voltage with the throttle valves fully closed. If the output voltage is out of specification, adjust the throttle position sensor.

NOTE:
To measure the output voltage, connect the positive tester probe to the pink wire of the test harness and the negative tester probe to the orange wire of the test harness.

Digital circuit tester: 90890-03174

Throttle position sensor output voltage:
Pink (P) - Black (B)
0.70 ± 0.02 V

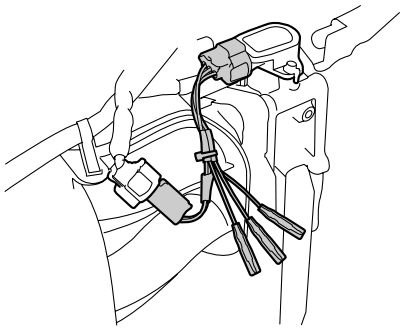
7. Install the intake silencer.
8. Start the engine and check the engine idle speed.

Digital tachometer: 90890-06760

Engine idle speed: 700 ± 50 r/min

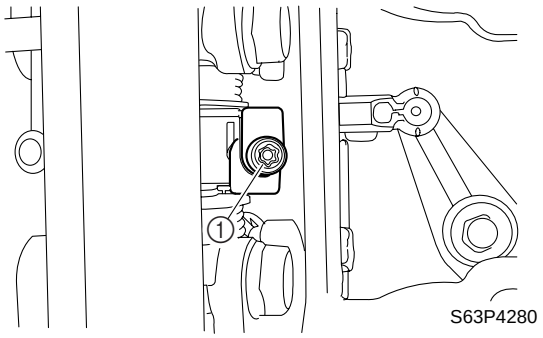
Adjusting the throttle position sensor (when disassembling or replacing the throttle body)

1. Install the intake assembly.
2. Connect the test harness (3 pins) to the throttle position sensor.


S63P8130

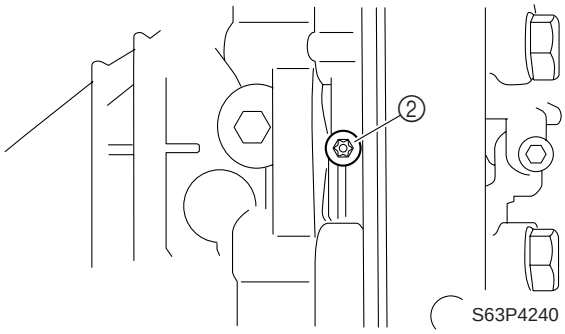
Test harness (3 pins): 90890-06793

3. Loosen the synchronizing screw ①.



S63P4280

4. Loosen the throttle stop screw ② and fully close the throttle valves #1 and #2.



S63P4240

5. Turn the engine start switch to ON.
6. Loosen the throttle position sensor screw and adjust the throttle position sensor output voltage to specification.

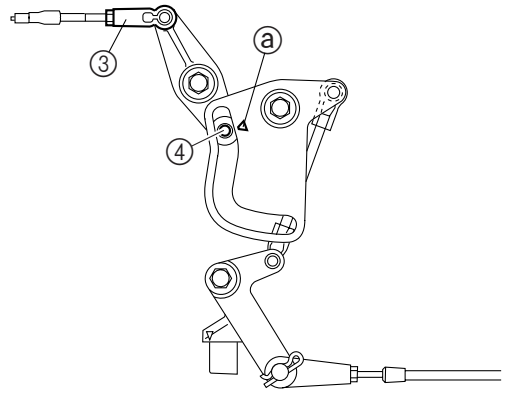
Throttle position sensor output voltage:
Pink (P) - Black (B)
0.66 V

7. Turn the throttle stop screw in until the throttle position sensor output voltage is within specification.

Throttle position sensor output voltage:
Pink (P) - Black (B)
0.70 ± 0.02 V

4

8. Install the throttle joint link rod ③ so that the throttle cam roller ④ is aligned with the alignment mark ⓐ as shown.



S63P4290

9. Synchronize the throttle valves. Refer to "Synchronizing the throttle valves."

10. Check the engine idle speed. If out of specification, repeat steps 3- 10.

Engine idle speed: 700 ± 50 r/min

— MEMO —

Power unit

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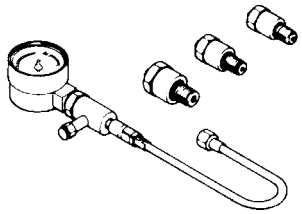
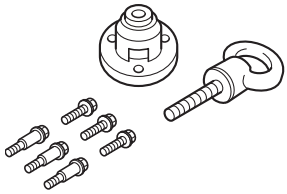
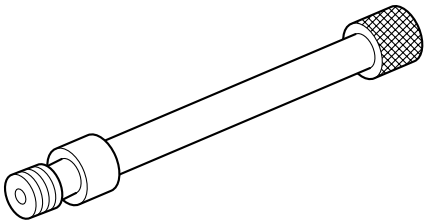
Special service tools



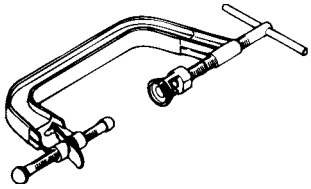
Compression gauge
90890-03160



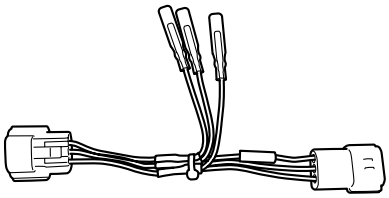
Flywheel puller
90890-06521



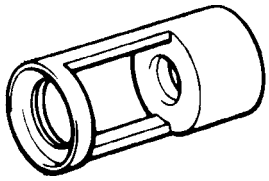
Compression gauge extension
90890-06563



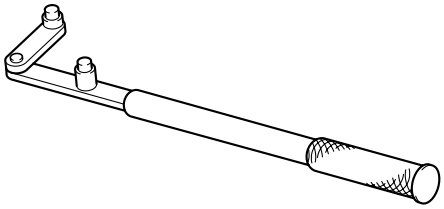
Valve spring compressor
90890-04019



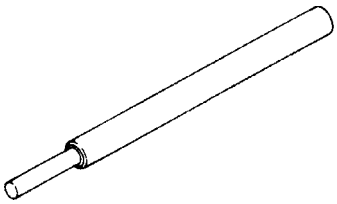
Test harness (3 pins)
New: 90890-06869
Current: 90890-06769



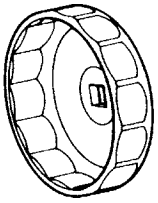
Valve spring compressor attachment
90890-06320



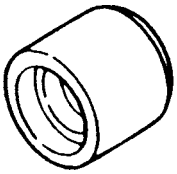
Flywheel holder
90890-06522



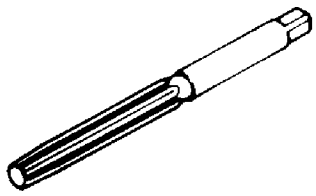
Valve guide remover/installer
90890-06801



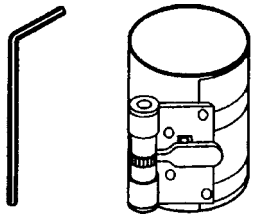
Oil filter wrench
90890-06830



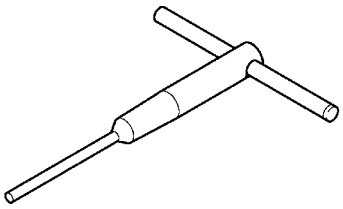
Valve guide installer
90890-06810



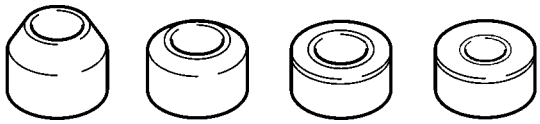
Valve guide reamer
90890-06804



Piston ring compressor
90890-05158

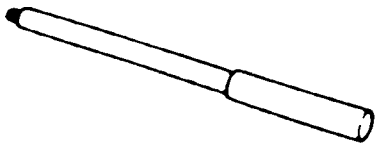


Valve seat cutter holder
90890-06316



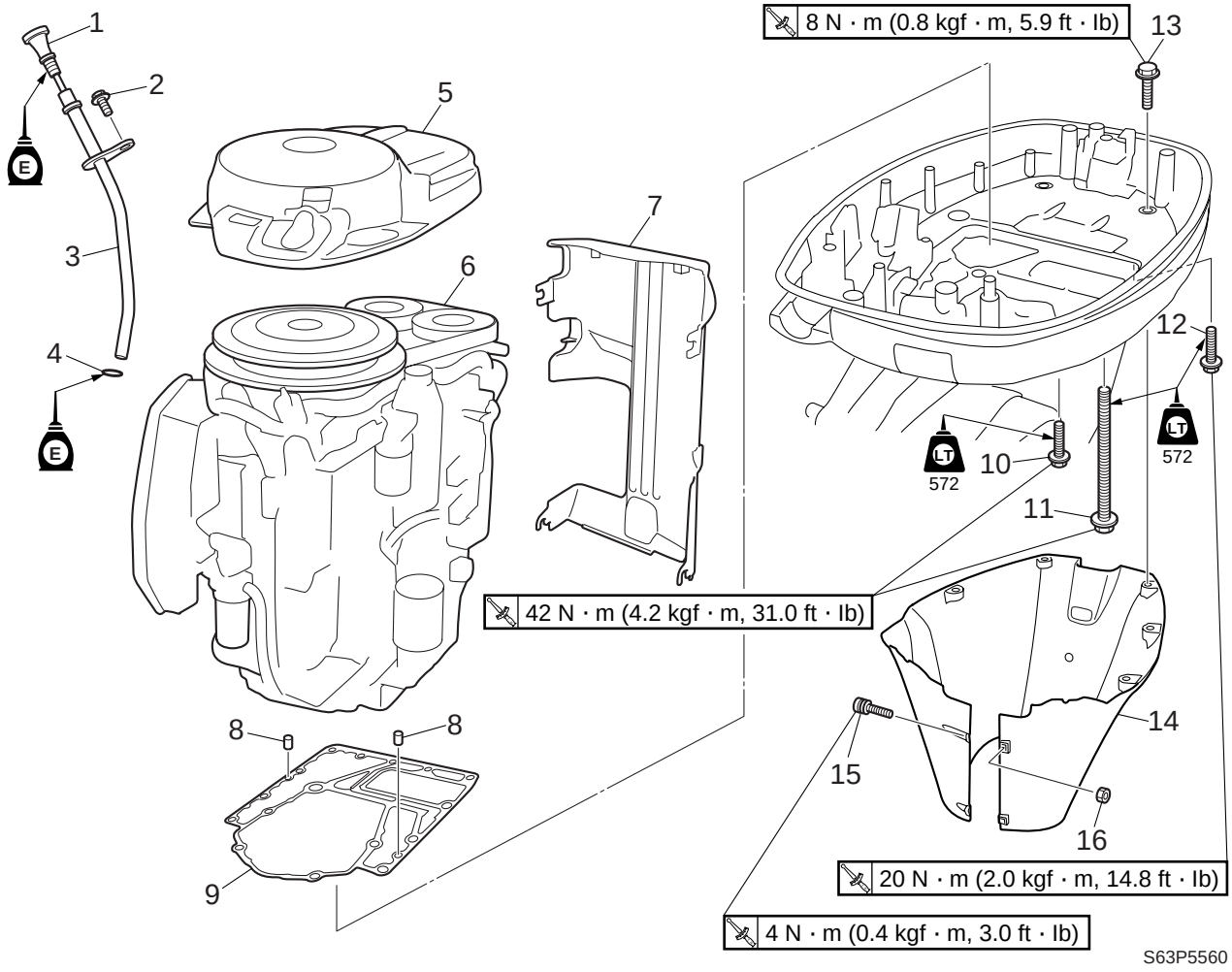
Valve seat cutter
90890-06324, 90890-06325, 90890-06326,
90890-06327

Needle bearing attachment
90890-06611, 90890-06654

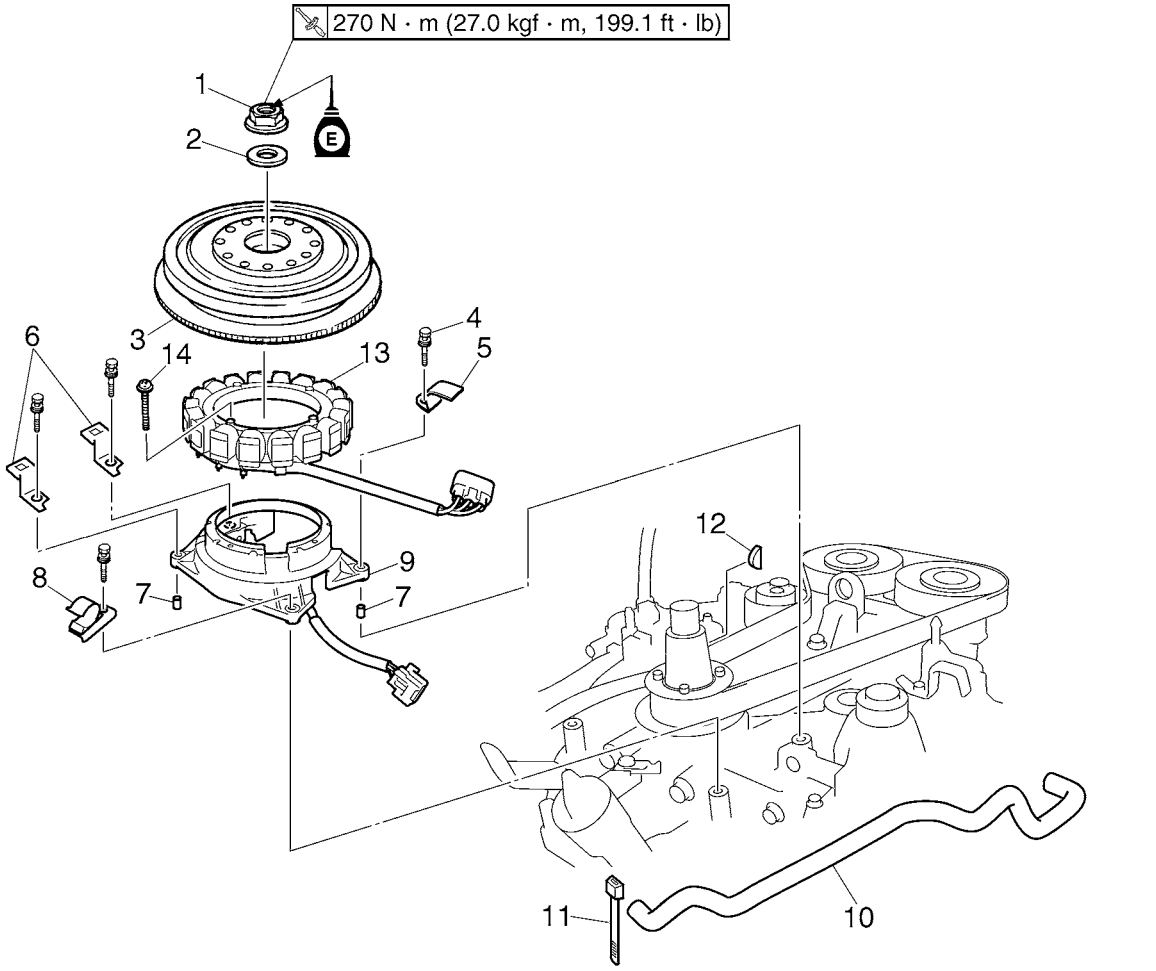


Driver rod L3
90890-06652

Power unit

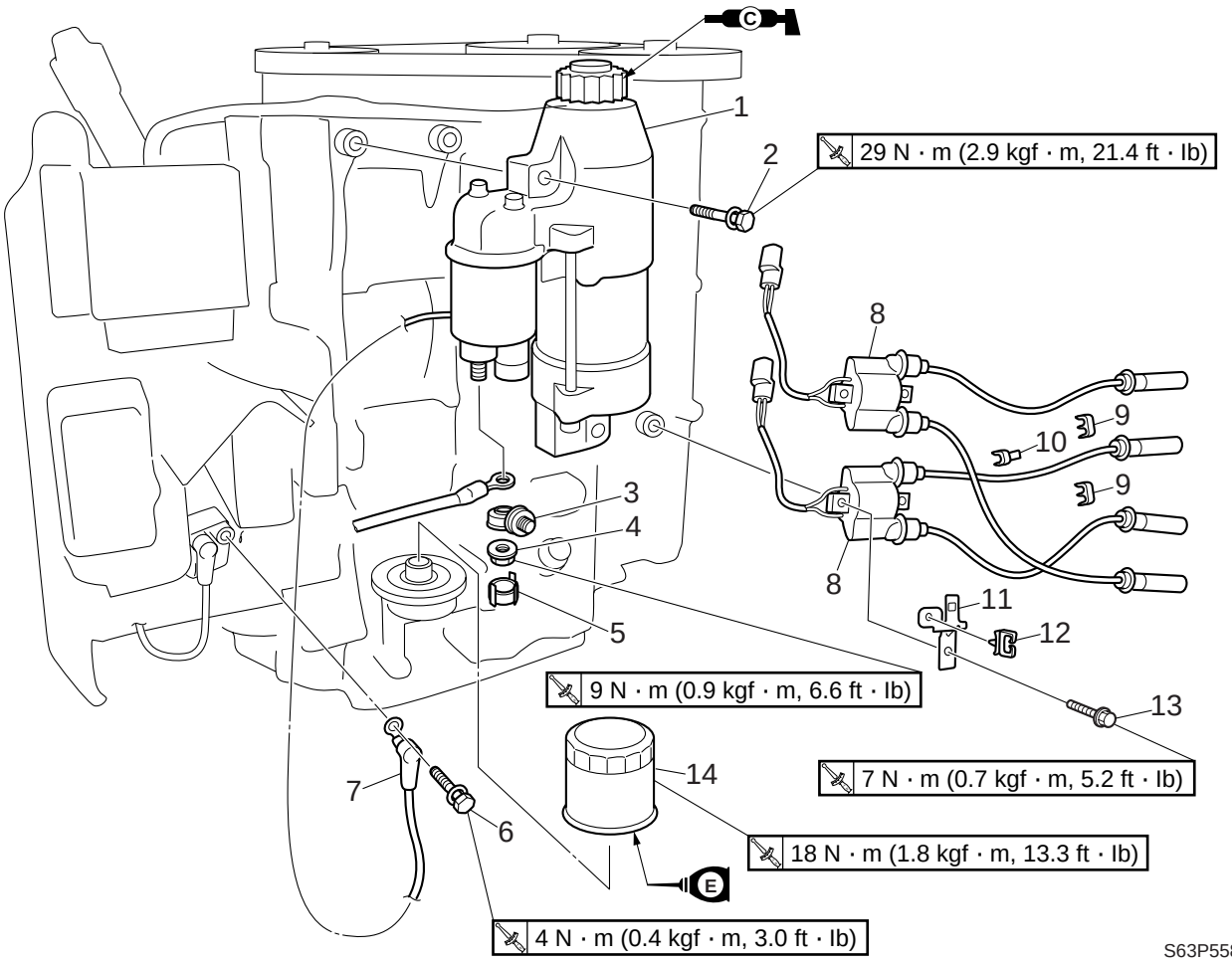


No.	Part name	Q'ty	Remarks
1	Dipstick	1	
2	Bolt	1	M6 × 20 mm
3	Dipstick guide	1	
4	O-ring	1	**Not reusable**
5	Flywheel magnet cover	1	
6	Power unit	1	
7	Spark plug wire cover	1	
8	Dowel	2	
9	Gasket	1	**Not reusable**
10	Bolt	4	M10 × 35 mm
11	Bolt	8	M10 × 140 mm
12	Bolt	3	M8 × 35 mm
13	Bolt	4	M6 × 16 mm
14	Apron	1	
15	Screw	2	ø6 × 40 mm
16	Nut	2	

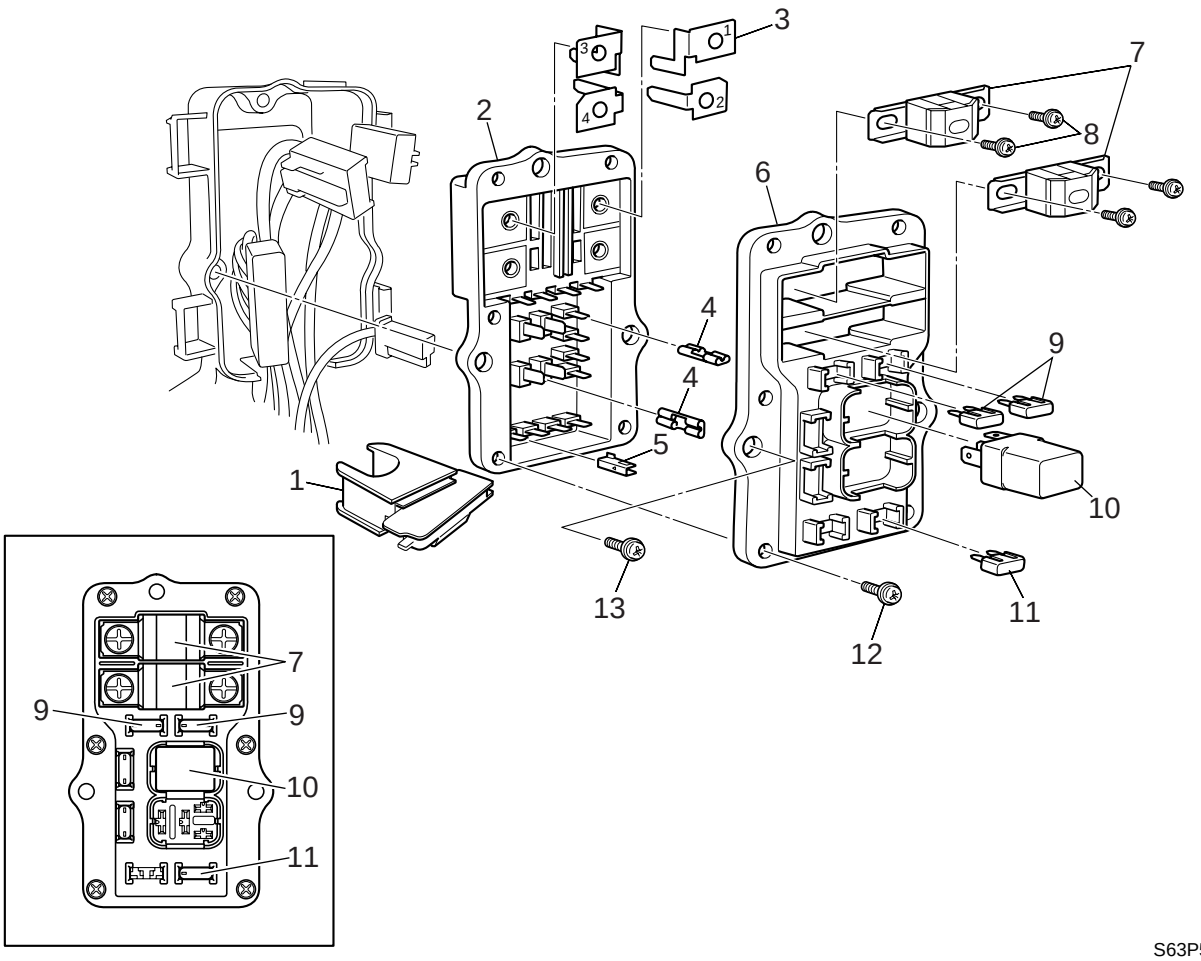


S63P5570

No.	Part name	Q'ty	Remarks
1	Nut	1	
2	Washer	1	
3	Flywheel magnet	1	
4	Bolt	4	M6 × 35 mm
5	Holder	1	
6	Bracket	2	
7	Collar	2	
8	Holder	1	
9	Stator coil bracket	1	
10	Hose	1	
11	Plastic tie	1	**Not reusable**
12	Woodruff key	1	
13	Stator coil	1	
14	Screw	4	ø6 × 30 mm

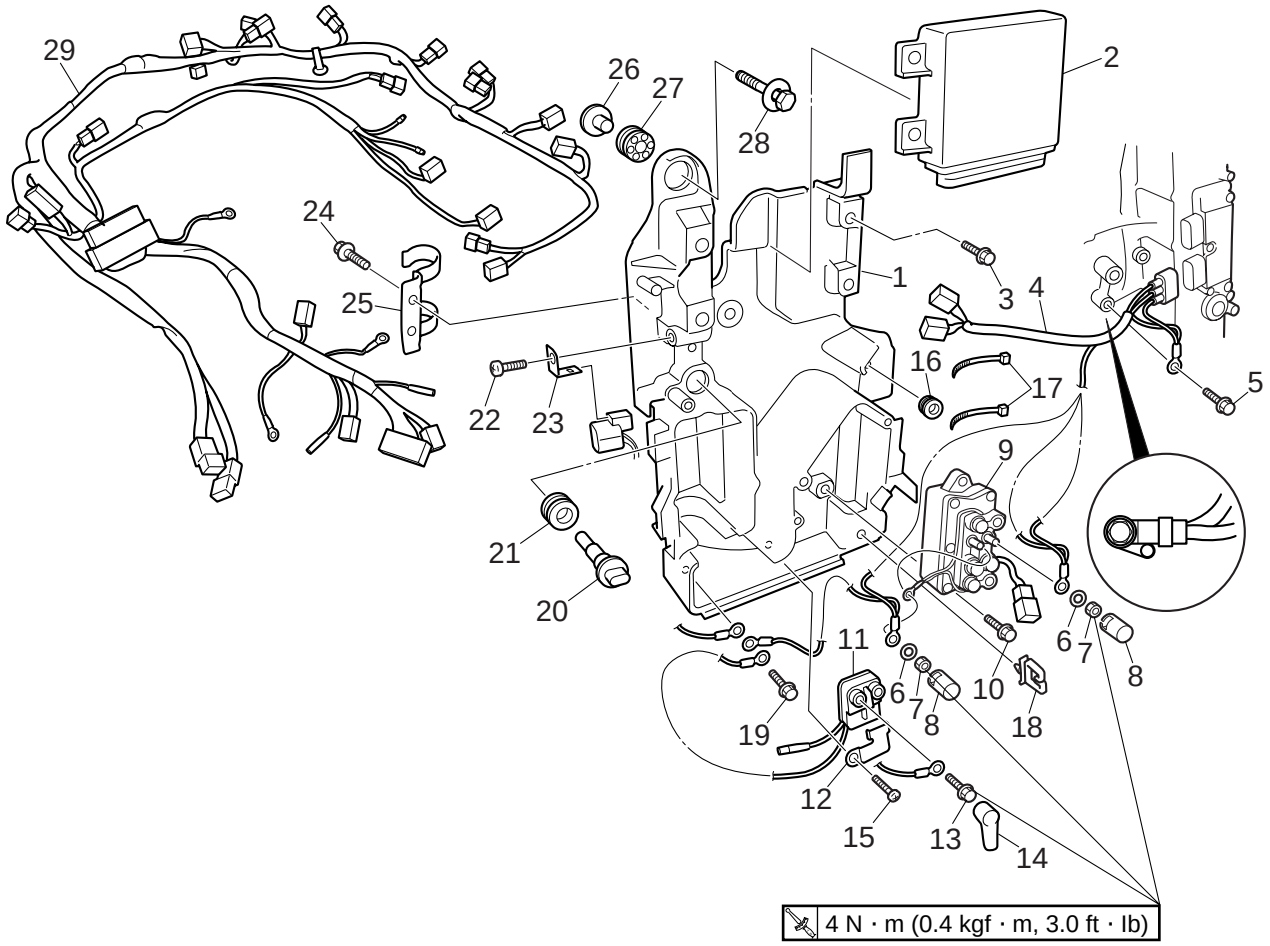


No.	Part name	Q'ty	Remarks
1	Starter motor	1	
2	Bolt	3	M8 × 45 mm
3	Terminal	1	
4	Nut	1	
5	Cap	1	
6	Bolt	1	M6 × 10 mm
7	Starter motor lead	1	
8	Ignition coil	2	
9	Holder	2	
10	Holder	1	
11	Bracket	2	
12	Holder	2	
13	Bolt	4	M6 × 25 mm
14	Oil filter	1	



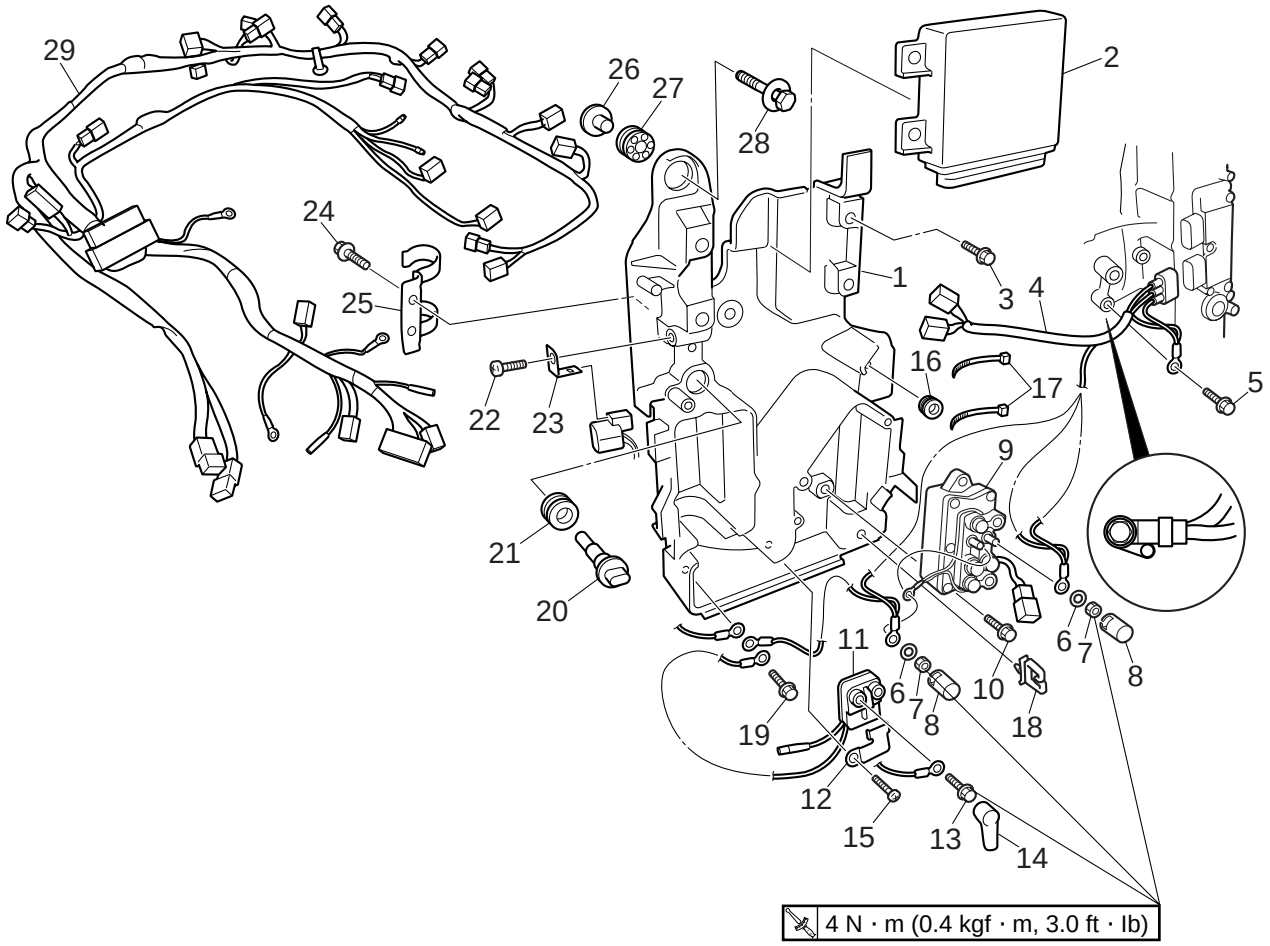
S63P5600

No.	Part name	Q'ty	Remarks
1	Grommet	1	
2	Fuse holder	1	
3	Terminal plate	4	
4	Terminal	8	
5	Terminal	8	
6	Fuse holder	1	
7	Fuse	2	50 A
8	Screw	4	ø5 × 10 mm
9	Fuse	2	20 A
10	Relay	1	
11	Fuse	1	30 A
12	Screw	6	ø3 × 10 mm
13	Screw	3	ø5 × 20 mm

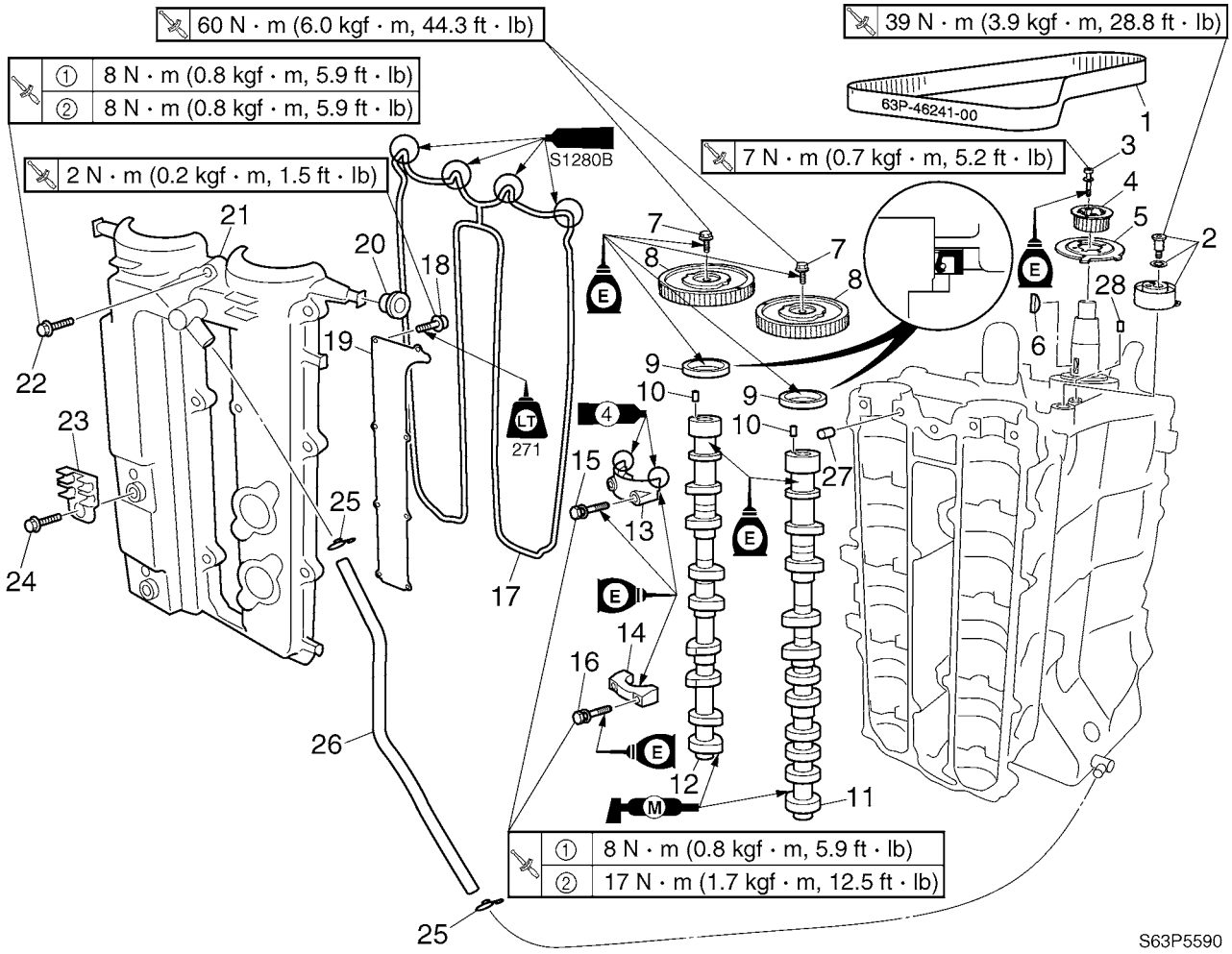


S63P5610

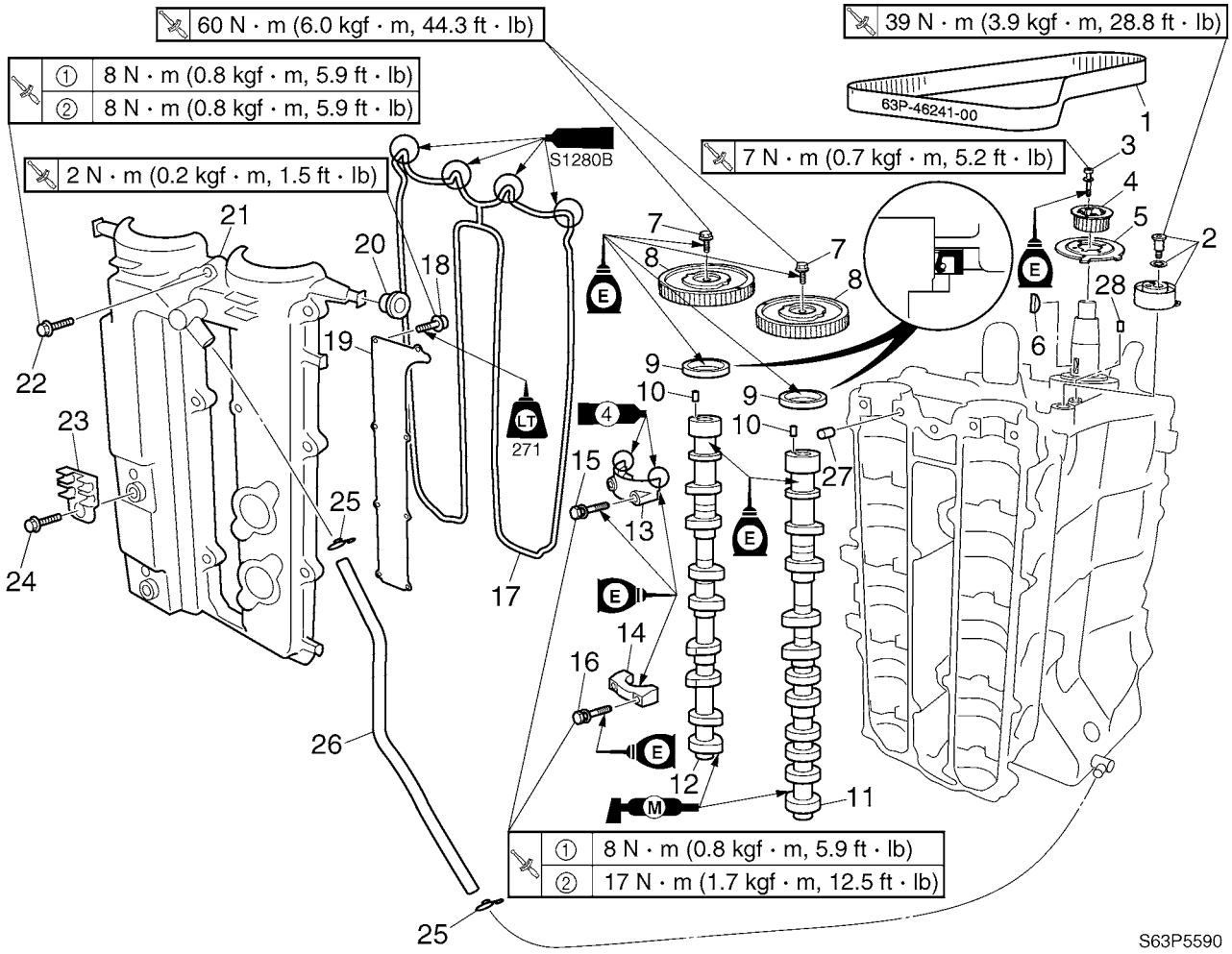
No.	Part name	Q'ty	Remarks
1	Junction box	1	
2	ECM	1	
3	Bolt	4	M6 × 16 mm
4	Wiring harness	1	
5	Bolt	1	M6 × 20 mm
6	Washer	2	
7	Nut	2	
8	Cap	2	
9	Power trim and tilt relay	1	
10	Bolt	2	M6 × 20 mm
11	Starter relay	1	
12	Holder	1	
13	Bolt	1	M6 × 10 mm
14	Cap	1	
15	Screw	1	ø6 × 19 mm
16	Grommet	1	
17	Plastic tie	2	**Not reusable**



No.	Part name	Q'ty	Remarks
18	Holder	1	
19	Bolt	1	M6 × 12 mm
20	Intake air temperature sensor	1	
21	Grommet	1	
22	Screw	1	ø6 × 19 mm
23	Bracket	1	
24	Screw	1	ø6 × 19 mm
25	Holder	1	
26	Collar	3	
27	Grommet	3	
28	Bolt	3	M6 × 35 mm
29	Wiring harness	1	


60 N · m (6.0 kgf · m, 44.3 ft · lb)
39 N · m (3.9 kgf · m, 28.8 ft · lb)
① 8 N · m (0.8 kgf · m, 5.9 ft · lb)
② 8 N · m (0.8 kgf · m, 5.9 ft · lb)
2 N · m (0.2 kgf · m, 1.5 ft · lb)
7 N · m (0.7 kgf · m, 5.2 ft · lb)
S1280B
63P-46241-00
LT
271
① 8 N · m (0.8 kgf · m, 5.9 ft · lb)
② 17 N · m (1.7 kgf · m, 12.5 ft · lb)
S63P5590

No.	Part name	Q'ty	Remarks
1	Timing belt	1	
2	Timing belt tensioner	1	
3	Bolt	4	M5 × 40 mm
4	Drive sprocket	1	
5	Plate	1	
6	Woodruff key	1	
7	Bolt	2	M10 × 35 mm
8	Driven sprocket	2	
9	Oil seal	2	
10	Dowel	2	
11	Camshaft	1	
12	Camshaft	1	
13	Camshaft cap	2	
14	Camshaft cap	8	
15	Bolt	4	M7 × 48 mm
16	Bolt	16	M7 × 37 mm
17	Gasket	1	**Not reusable**


60 N · m (6.0 kgf · m, 44.3 ft · lb)
39 N · m (3.9 kgf · m, 28.8 ft · lb)
① 8 N · m (0.8 kgf · m, 5.9 ft · lb)
② 8 N · m (0.8 kgf · m, 5.9 ft · lb)
2 N · m (0.2 kgf · m, 1.5 ft · lb)
7 N · m (0.7 kgf · m, 5.2 ft · lb)
63P-46241-00
S1280B
LT
271
① 8 N · m (0.8 kgf · m, 5.9 ft · lb)
② 17 N · m (1.7 kgf · m, 12.5 ft · lb)
S63P5590

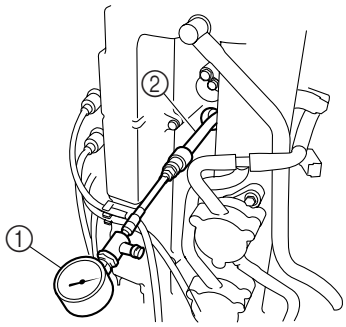
No.	Part name	Q'ty	Remarks
18	Screw	8	ø4 × 8 mm
19	Plate	1	
20	Grommet	6	
21	Cylinder head cover	1	
22	Bolt	15	M6 × 30 mm
23	Holder	2	
24	Bolt	2	M6 × 10 mm
25	Clamp	2	
26	Hose	1	
27	Dowel	4	
28	Dowel	1	

Checking the compression pressure

1. Start the engine, warm it up for 5 minutes, and then turn it off.

2. Remove the engine stop lanyard from the engine stop lanyard switch on the remote control box.

3. Remove the spark plug wire cover and all spark plugs, and then install the special service tools into a spark plug hole.



S63P5010

CAUTION:

Before removing the spark plugs, blow compressed air in the spark plug well to clear out any dirt or dust that may fall into the cylinder.

Compression gauge ①:
90890-03160
Compression gauge extension ②:
90890-06563

4. Fully open the throttle, crank the engine until the reading on the compression gauge stabilizes, and then check the compression pressure.

Minimum compression pressure (reference data):
880 kPa (8.8 kgf/cm^2, 128 psi)

5. If the compression pressure is below specification and the compression pressure for each cylinder is unbalanced, add a small amount of engine oil to the cylinder, and then check the pressure again.

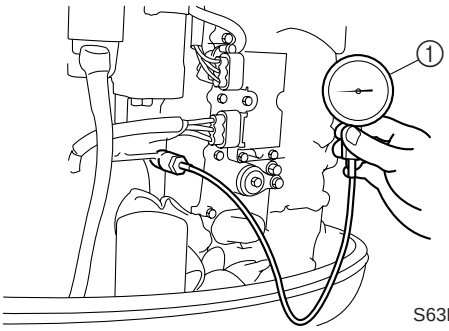
NOTE:

- If the compression pressure increases, check the pistons and piston rings for wear. Replace if necessary.
- If the compression pressure does not increase, check the valve clearance, valve, valve seat, cylinder sleeve, cylinder head gasket, and cylinder head. Adjust or replace if necessary.

Checking the oil pressure

1. Place a rag under the oil pressure sensor.

2. Remove the oil pressure sensor, and then install an oil pressure gauge ① to the oil pressure sensor installation hole.



S63P5020

NOTE:
Use a general pressure gauge.

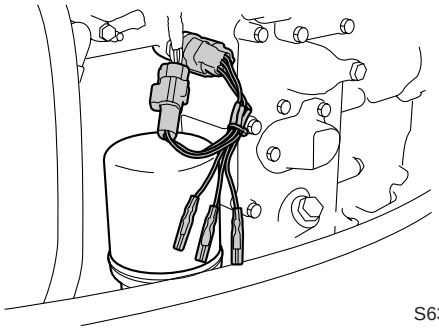
3. Start the engine and warm it up for 5 minutes.

4. Check the oil pressure. Check the oil pump, oil leakage, and oil strainer if out of specification.

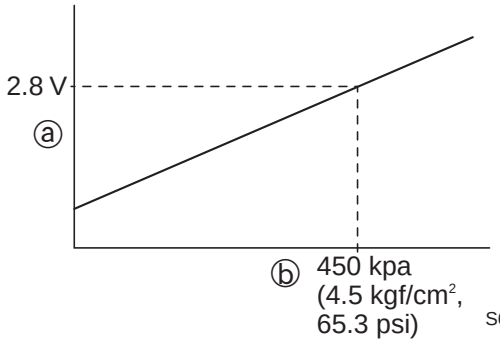
Oil pressure (reference data):
450 kPa (4.5 kgf/cm^2, 65.3 psi) at engine idle speed

Checking the oil pressure sensor

1. Connect the test harness (3 pins) to the oil pressure sensor.
2. Start the engine and warm it up for 5 minutes.
3. Measure the oil pressure sensor input voltage. Check the wiring harness connection or replace the ECM if out of specification.
4. Measure the oil pressure sensor output voltage. Replace if out of specification.



S63P5030



S63P5040

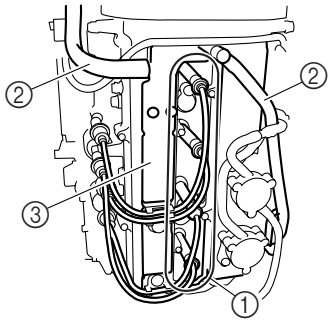
ⓐ: Output voltage
ⓑ: Oil pressure

Test harness (3 pins):
New: 90890-06869
Current: 90890-06769

Oil pressure sensor input voltage:
Orange (O) – Black (B)
5 V
Oil pressure sensor output voltage (reference data):
Pink/white (P/W) – Black (B)
2.8 V at engine idle speed

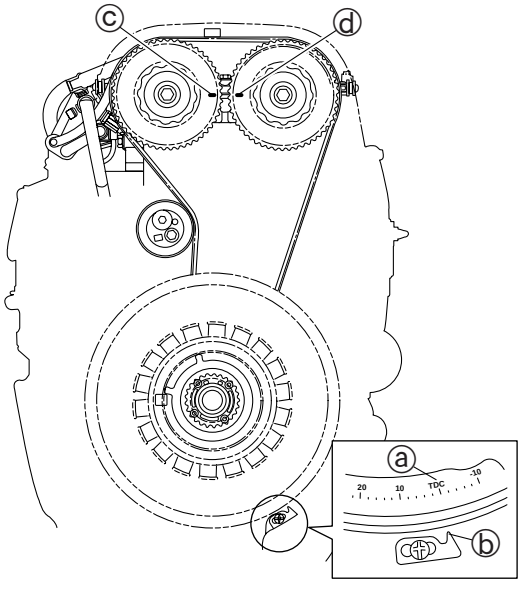
Checking the valve clearance

1. Remove the flywheel magnet cover and spark plug wire cover.
2. Disconnect the fuel hoses from the fuel pumps.
3. Disconnect the spark plug wires ①, and remove the blowby hoses ②, spark plugs, and cylinder head cover ③.



S63P5050

4. Turn the flywheel magnet clockwise and align the "TDC" mark ⓐ on the flywheel magnet with the pointer ⓑ, and check that "I" marks ⓒ and ⓓ on the driven sprockets are aligned.



S63P5060

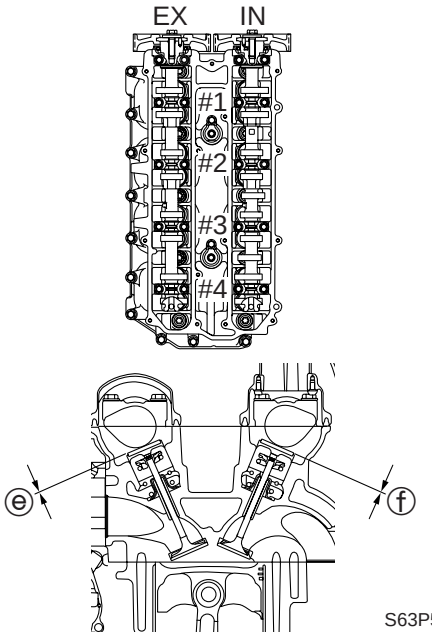
NOTE:
Do not turn the flywheel magnet counterclockwise.

5

5. Check the intake valve clearance for cylinders #1 and #2, and exhaust valve clearance for cylinders #1 and #3. Adjust if out of specification.

6. Turn the flywheel magnet 360° clockwise.

7. Check the intake valve clearance for cylinders #3 and #4, and exhaust valve clearance for cylinders #2 and #4. Adjust if out of specification.



NOTE:
- Check the valve clearance when the engine is cold.
- Note the measurement.

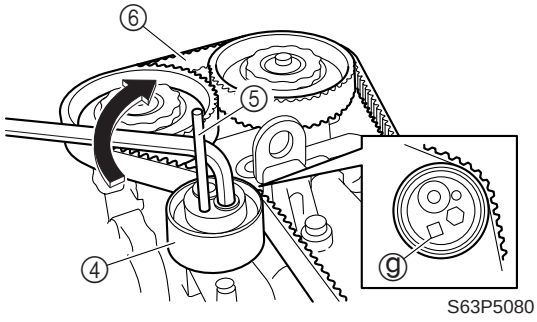
Valve clearance:
Intake ⓔ:
0.20 ± 0.03 mm (0.008 ± 0.001 in)
Exhaust ⓕ:
0.34 ± 0.03 mm (0.013 ± 0.001 in)

8. Turn the flywheel magnet 360° clockwise and align the "TDC" mark on the flywheel magnet with the pointer, and check that the "I" marks on the driven sprockets are aligned.

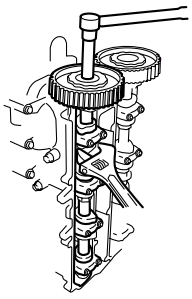
9. Using a hexagon wrench, turn the timing belt tensioner ④ clockwise to push the timing belt, increase strength gradually, and then insert a ø5.0 mm (0.2 in) pin ⑤ into the hole ⓖ.

NOTE:
Leave the pin inserted into the timing belt tensioner until the timing belt has been installed.

10. Remove the timing belt ⑥ from the driven sprockets.

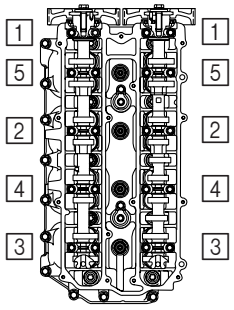


11. Remove the driven sprockets.



NOTE:
Hold the camshaft using a wrench, and be careful not to damage the driven sprocket.

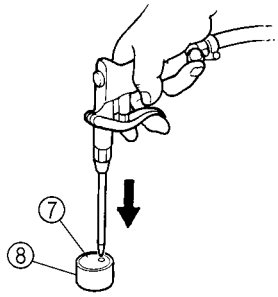
12. Remove the camshaft caps in the order shown in the illustration.



S63P5100

13. Remove the camshafts.

14. Remove the valve shim ⑦ from the valve lifter ⑧ using compressed air.



S63P5C60

NOTE:
Do not mix the valve train parts. Keep them organized in their proper groups.

15. Measure the valve shim thickness using a micrometer, and then note the measurement.

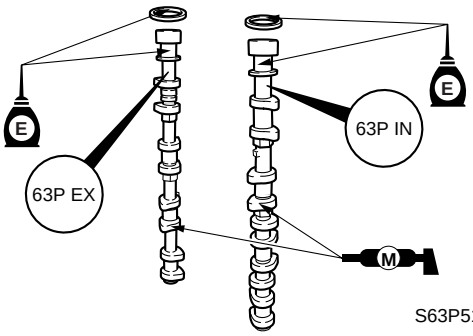
16. Select the necessary valve shim by calculating its thickness using the following formula.

Necessary valve shim thickness = Removed valve shim thickness + Measured valve clearance – Specified valve clearance

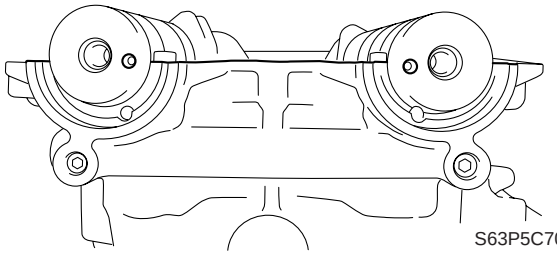
Example:
If the “Removed valve shim thickness” is 2.10 mm, the “Measured valve clearance” is 0.30 mm and the “Specified valve clearance” is 0.20 mm, then the “Necessary valve shim thickness” = 2.10 + 0.30 – 0.20 = 2.20 mm

17. Install the necessary valve shim into the valve lifter.

18. Install the camshafts into the cylinder head with new oil seals.



S63P5110

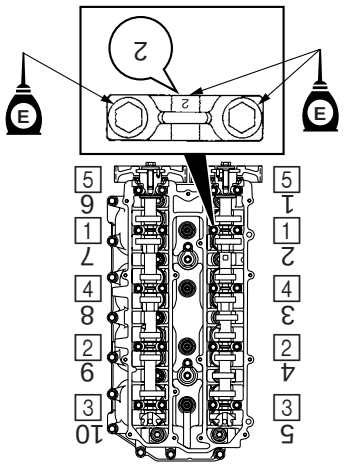


S63P5C70

NOTE:
Install the camshafts so that the dowels are facing inward and that they are aligned with the mating surface of the cylinder head.

5

19. Install the camshaft caps, and then tighten them to the specified torques in two stages and in the sequence shown in the illustration.

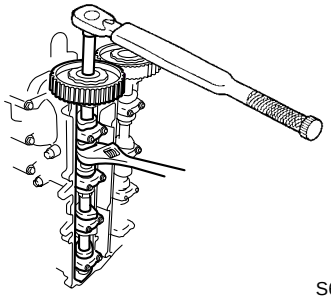


S63P5120

NOTE:
- Install the camshaft caps in the proper position as shown and with the stamped numbers facing upside down.
- Apply engine oil to the camshaft cap bolts before installation.

Camshaft cap bolt:
1st: 8 N·m (0.8 kgf·m, 5.9 ft·lb)
2nd: 17 N·m (1.7 kgf·m, 12.5 ft·lb)

20. Install the driven sprockets, and then tighten the bolts to the specified torque.

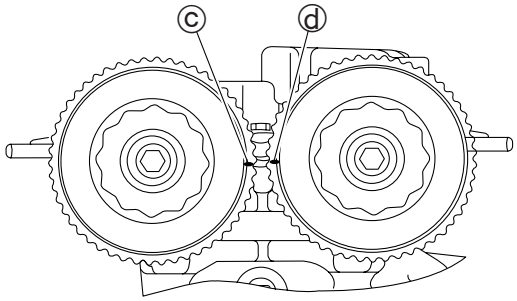


S63P5130

NOTE:
Apply engine oil to the driven sprocket bolts before installation.

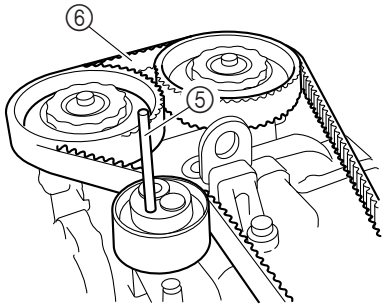
Driven sprocket bolt:
60 N·m (6.0 kgf·m, 44.3 ft·lb)

21. Check that "I" marks ⓒ and ⓓ on the driven sprockets are aligned. Adjust if necessary.



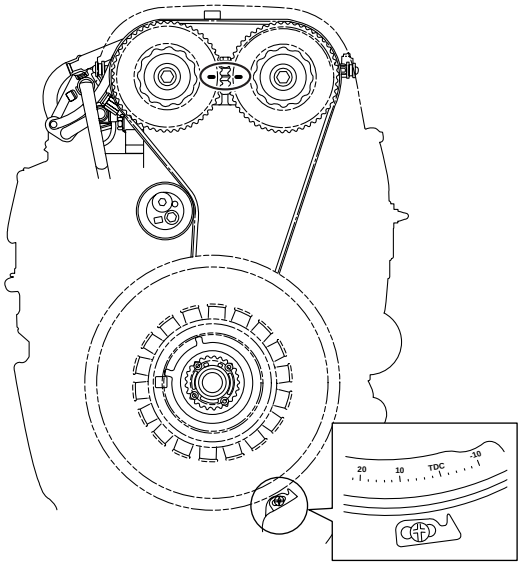
S63P5140

22. Install the timing belt ⑥, turn the belt from the drive sprocket side a half turn counterclockwise to align it, and then remove the pin ⑤.



S63P5C90

23. Turn the flywheel magnet clockwise two turns, and then check that all alignment marks are aligned.



S63P5160

NOTE:
Do not turn the flywheel magnet counterclockwise.

24. Check the valve clearances. Adjust if necessary.

25. Install the spark plugs, and then tighten them to the specified torque.

26. Install the cylinder head cover bolts, and then tighten them to the specified torques in two stages.

Spark plug:
25 N·m (2.5 kgf·m, 18.4 ft·lb)
Cylinder head cover bolt:
1st: 8 N·m (0.8 kgf·m, 5.9 ft·lb)
2nd: 8 N·m (0.8 kgf·m, 5.9 ft·lb)

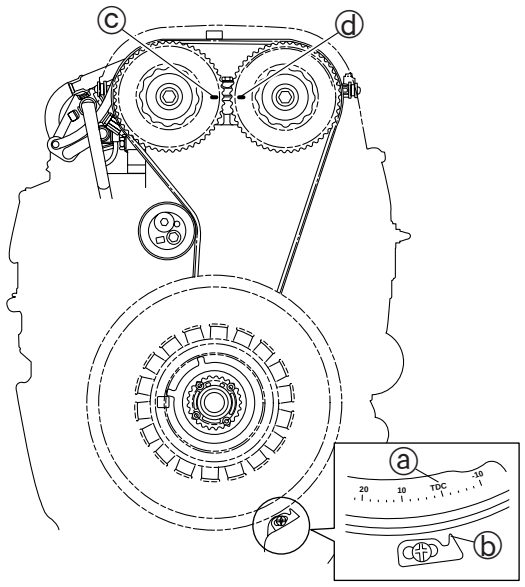
27. Install the blowby hoses, and connect the spark plug caps.

28. Install the spark plug wire cover and flywheel magnet cover.

Replacing the timing belt

1. Remove the flywheel magnet cover.

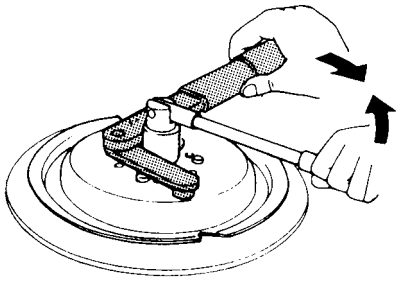
2. Turn the flywheel magnet clockwise and align the "TDC" mark ⓐ on the flywheel magnet with the pointer ⓑ, and check that "I" marks ⓒ and ⓓ on the driven sprockets are aligned.



S63P5060

NOTE:
Do not turn the flywheel magnet counterclockwise.

3. Loosen the flywheel magnet nut.

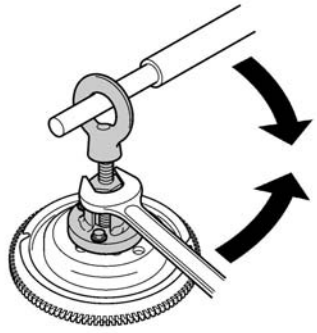


S63P5260

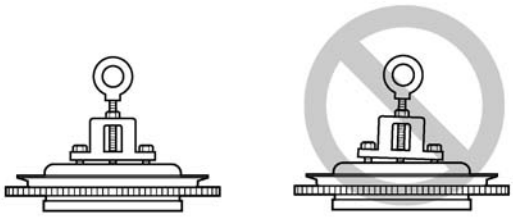
CAUTION:
Apply force in the direction of the arrows shown to prevent the flywheel holder from slipping off easily.

Flywheel holder: 90890-06522

4. Remove the flywheel magnet.



S63P5280



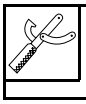
S63P5290

CAUTION:

To prevent damage to the engine or tools, screw in the puller set bolts evenly and completely so that the puller plate is parallel to the flywheel magnet.

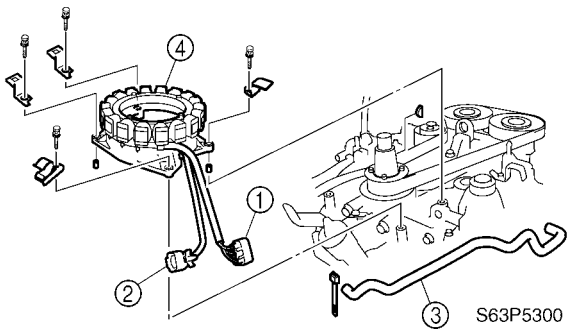
NOTE:

Apply force to the crankshaft end until the flywheel magnet comes off the tapered portion of the crankshaft.



Flywheel puller: 90890-06521

5. Disconnect the stator coil coupler ① and pulser coil coupler ②, and remove the blowby hose ③ and stator assembly ④.



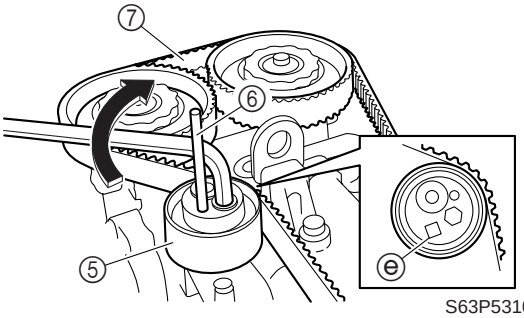
S63P5300

6. Using a hexagon wrench, turn the timing belt tensioner ⑤ clockwise to push the timing belt, increase strength gradually, and then insert a ø5.0 mm (0.2 in) pin ⑥ into the hole ⓔ.

NOTE:

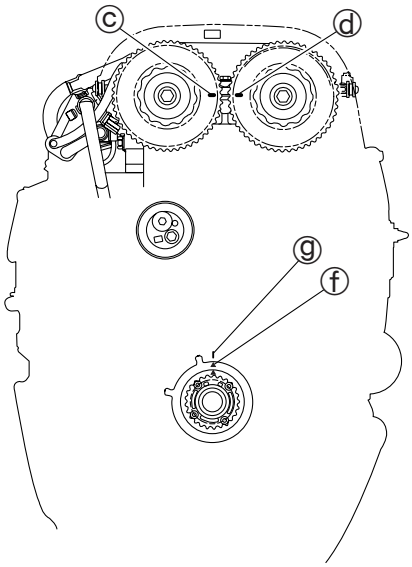
Leave the pin inserted into the timing belt tensioner until the timing belt has been installed.

7. Remove the timing belt ⑦ from the driven sprocket side.



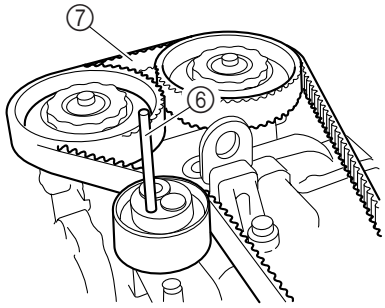
S63P5310

8. Check that "I" marks ⓒ and ⓓ on the driven sprockets are aligned, and that the "▲" mark ⓕ on the plate is aligned with the "I" mark ⓖ on the cylinder block. Align if necessary.

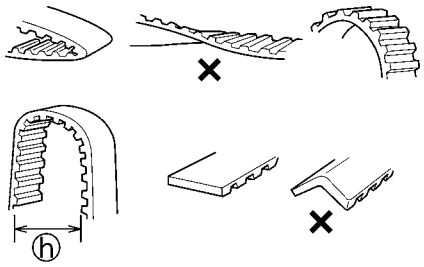


S63P5320

9. Install a new timing belt ⑦ from the drive sprocket side with its part number in the upright position, turn the belt a half turn counterclockwise to align it, and then remove the pin ⑥.



S63P5330



S63P5340

CAUTION:

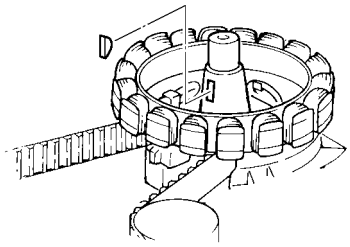
- **Do not twist, turn inside out, or bend the timing belt beyond the maximum limit of 25 mm (1.0 in) ⓗ, otherwise it can be damaged.**
- **Do not get oil or grease on the timing belt.**

10. Turn the drive sprocket clockwise two turns, and then check that all alignment marks are aligned.

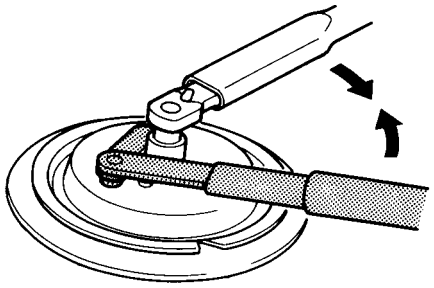
NOTE:
Do not turn the drive sprocket counterclockwise.

11. Install the stator assembly, and blowby hose, and connect the pulser coil coupler and stator coil coupler.

12. Install the Woodruff key.

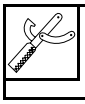

S63P5350

13. Install the flywheel magnet.


S63P5370

CAUTION:
Apply force in the direction of the arrows shown to prevent the flywheel holder from slipping off easily.

NOTE:
Apply engine oil to the flywheel magnet nut before installation.

	Flywheel holder: 90890-06522

	Flywheel magnet nut: 270 N·m (27.0 kgf·m, 199.1 ft·lb)

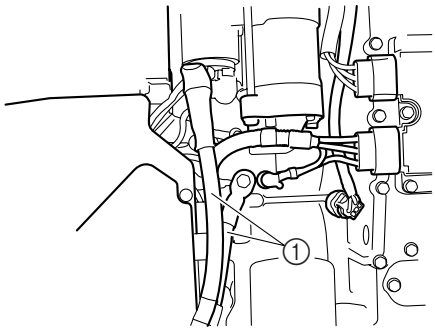
14. Install the flywheel magnet cover.

Removing the power unit

NOTE:
It is recommended to loosen the flywheel magnet nut before removing the power unit to improve working efficiency.

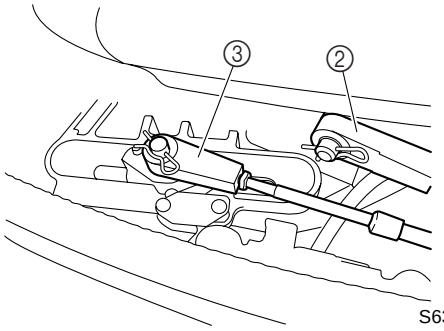
1. Remove the flywheel magnet cover.

2. Disconnect the battery leads ①.



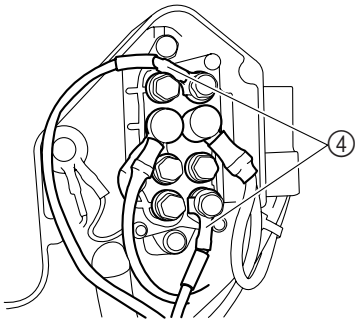
S63P5380

3. Disconnect the throttle cable ② and shift cable ③.



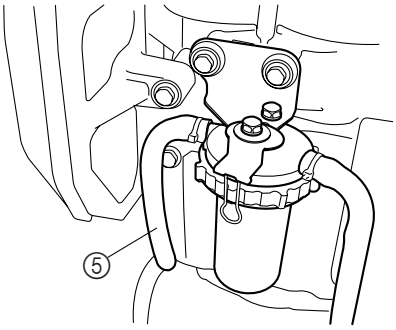
S63P5390

4. Remove the junction box cover, and then disconnect the PTT motor leads ④.



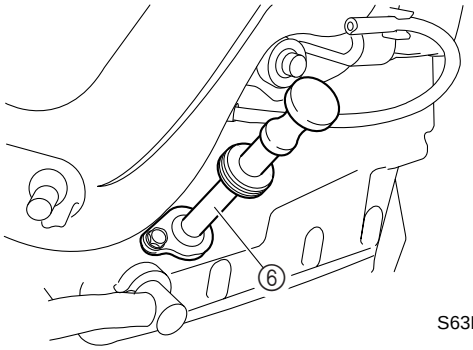
S63P5400

5. Disconnect the fuel hose ⑤.



S63P5410

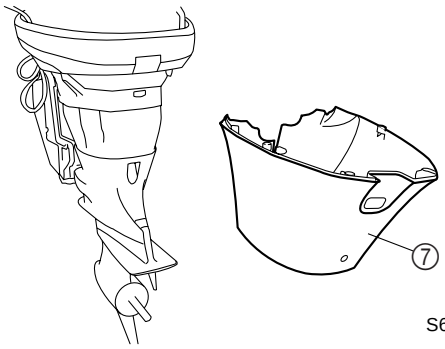
6. Remove the dipstick guide ⑥.



S63P5420

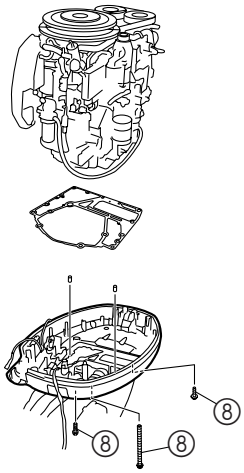
7. Disconnect the PTT switch coupler, shift cut switch coupler, neutral switch coupler, cooling water pilot hose, and flushing hose.

8. Remove the apron ⑦.



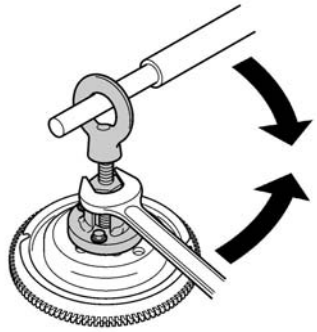
S63P5430

9. Remove the power unit by removing the bolts ⑧.

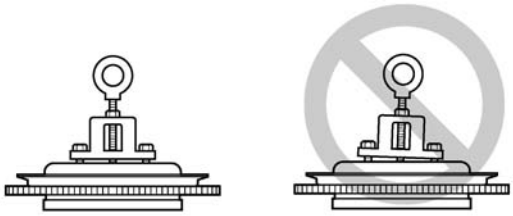


S63P5440

10. Remove the flywheel magnet.



S63P5280



S63P5290

CAUTION:

To prevent damage to the engine or tools, screw in the puller set bolts evenly and completely so that the puller plate is parallel to the flywheel magnet.

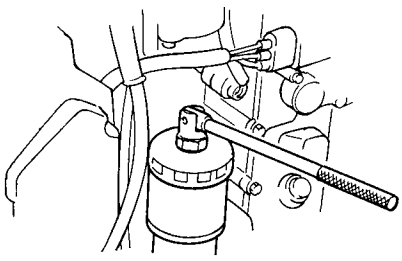
NOTE:

Apply force to the crankshaft end until the flywheel magnet comes off the tapered portion of the crankshaft.

Flywheel puller: 90890-06521

Removing the oil filter

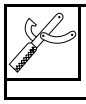
1. Place a rag under the oil filter, and then remove the filter using a 72.5 mm (2.9 in) oil filter wrench.



S63P5920

NOTE:

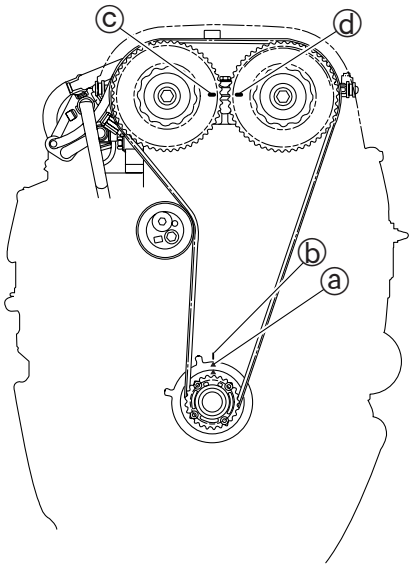
Be sure to clean up any oil spills.



Oil filter wrench: 90890-06830

Removing the timing belt and sprockets

1. Turn the drive sprocket clockwise and align the "▲" mark ⓐ on the plate with the "I" mark ⓑ on the cylinder block, and check that "I" marks ⓒ and ⓓ on the driven sprockets are aligned.



S63P5450

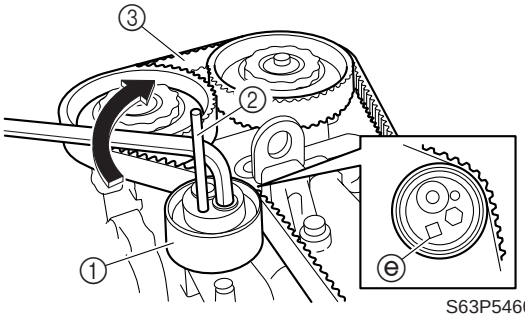
NOTE:

Do not turn the drive sprocket counterclockwise.

5

2. Using a hexagon wrench, turn the timing belt tensioner ① clockwise to push the timing belt, increase strength gradually, and then insert a ø5.0 mm (0.2 in) pin ② into the hole ⓔ.

3. Remove the timing belt ③ from the driven sprocket side.



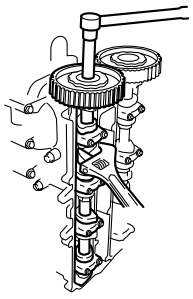
S63P5460

4. Remove the timing belt tensioner.

NOTE:
Do not remove the pin ② from the timing belt tensioner.

5. Remove the drive sprocket and plate.

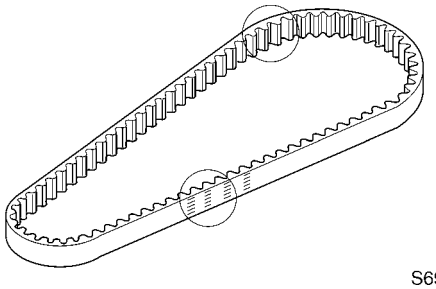
6. Remove the cylinder head cover, and then remove the driven sprockets.


S63P5090

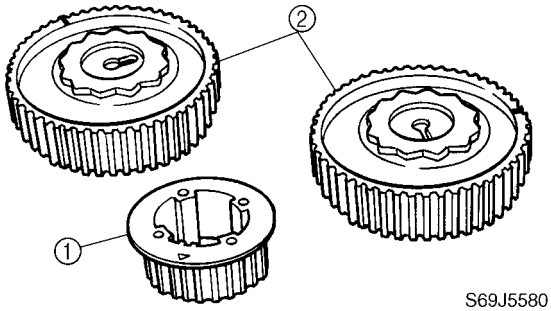
NOTE:
Hold the camshaft using a wrench, and be careful not to damage the driven sprocket.

Checking the timing belt and sprockets

1. Check the interior and exterior of the timing belt for cracks, damage, or wear. Replace if necessary.


S69J5570

2. Check the drive sprocket ① and driven sprockets ② for cracks, damage, or wear. Replace if necessary.



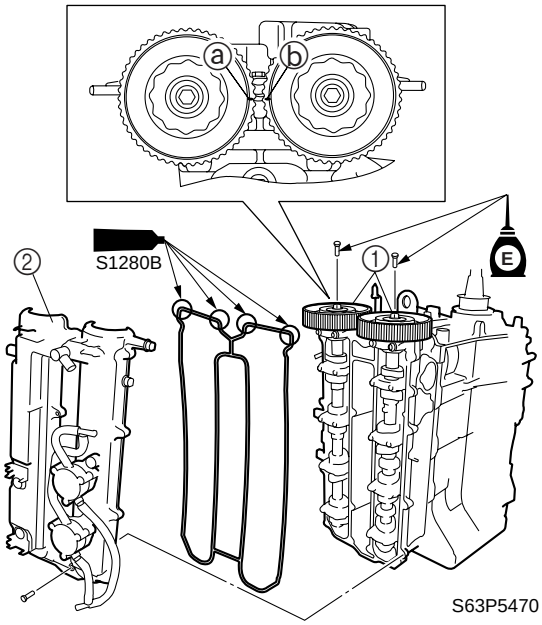
S69J5580

Installing the sprockets and timing belt

1. Install the driven sprockets ①, and then tighten the bolts to the specified torque.

2. Check that "I" marks ⓐ and ⓑ on the driven sprockets are aligned.

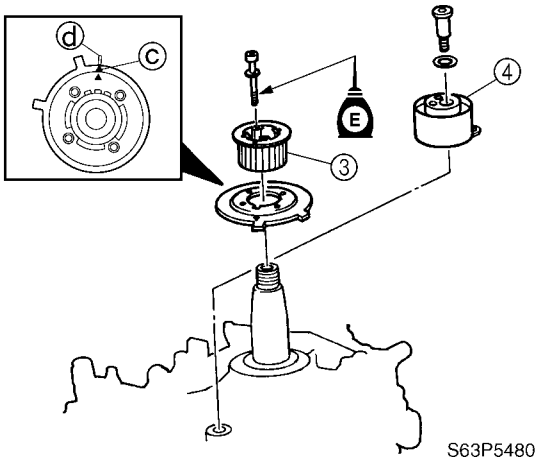
3. Install a new gasket and the cylinder head cover ②, and then tighten the bolts to the specified torques in two stages.



Driven sprocket bolt:
60 N·m (6.0 kgf·m, 44.3 ft·lb)
Cylinder head cover bolt:
1st: 8 N·m (0.8 kgf·m, 5.9 ft·lb)
2nd: 8 N·m (0.8 kgf·m, 5.9 ft·lb)

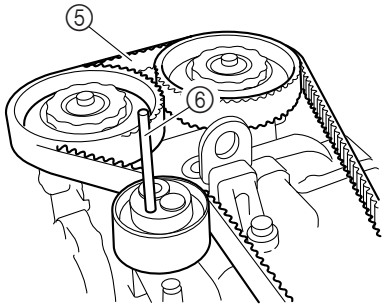
4. Install the drive sprocket ③ and timing belt tensioner ④, and then tighten the bolts to the specified torques.

5. Check that the "▲" mark ⓒ on the plate is aligned with the "I" mark ⓓ on the cylinder block. Align if necessary.

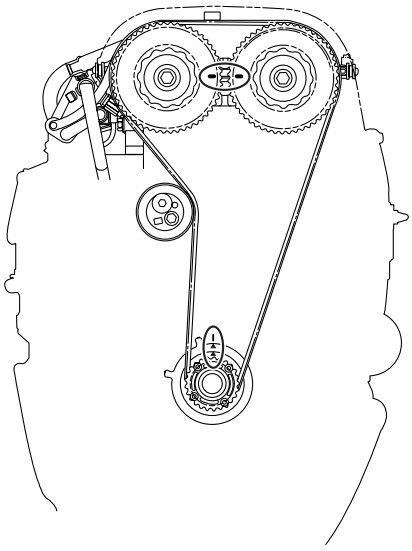


Drive sprocket bolt:
7 N·m (0.7 kgf·m, 5.2 ft·lb)
Timing belt tensioner bolt:
39 N·m (3.9 kgf·m, 28.8 ft·lb)

6. Install the timing belt ⑤ from the drive sprocket side with its part number in the upright position, turn the belt a half turn counterclockwise to align it, and then remove the pin ⑥.



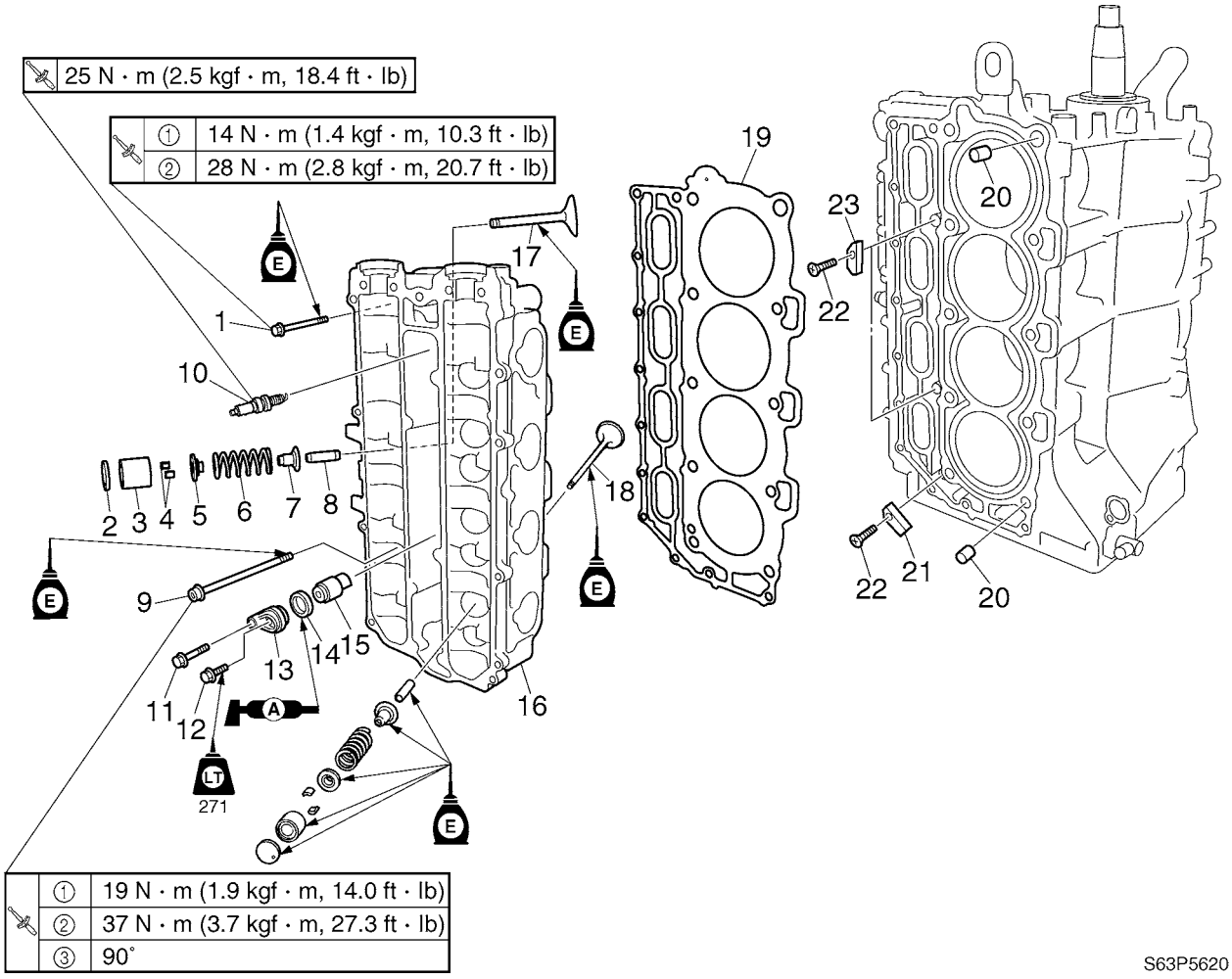
7. Turn the drive sprocket clockwise two turns, and then check that the alignment marks are aligned.



NOTE:
Do not turn the drive sprocket counterclockwise.

5

Cylinder head


25 N · m (2.5 kgf · m, 18.4 ft · lb)
① 14 N · m (1.4 kgf · m, 10.3 ft · lb)
② 28 N · m (2.8 kgf · m, 20.7 ft · lb)
① 19 N · m (1.9 kgf · m, 14.0 ft · lb)
② 37 N · m (3.7 kgf · m, 27.3 ft · lb)
③ 90°
E
A
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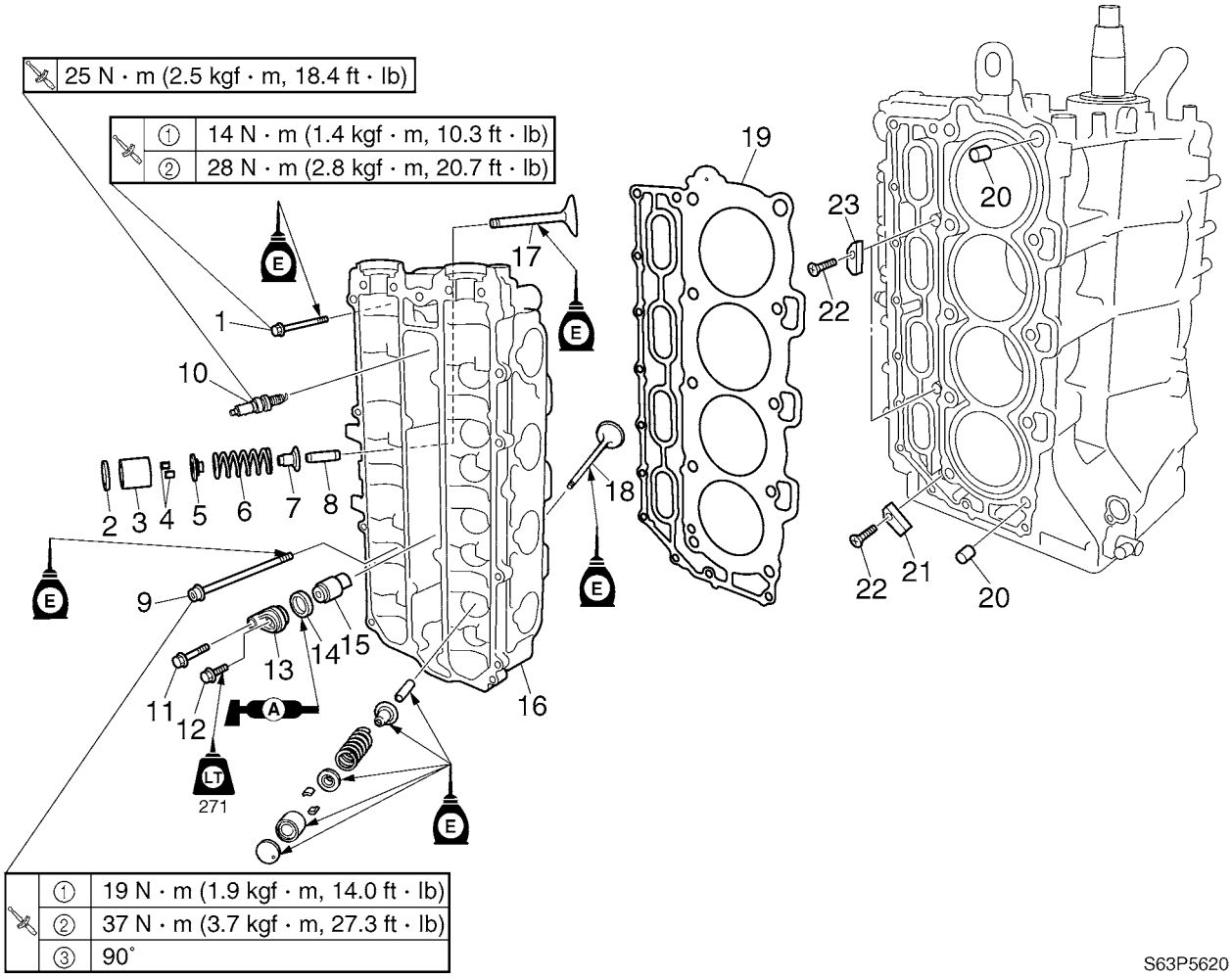
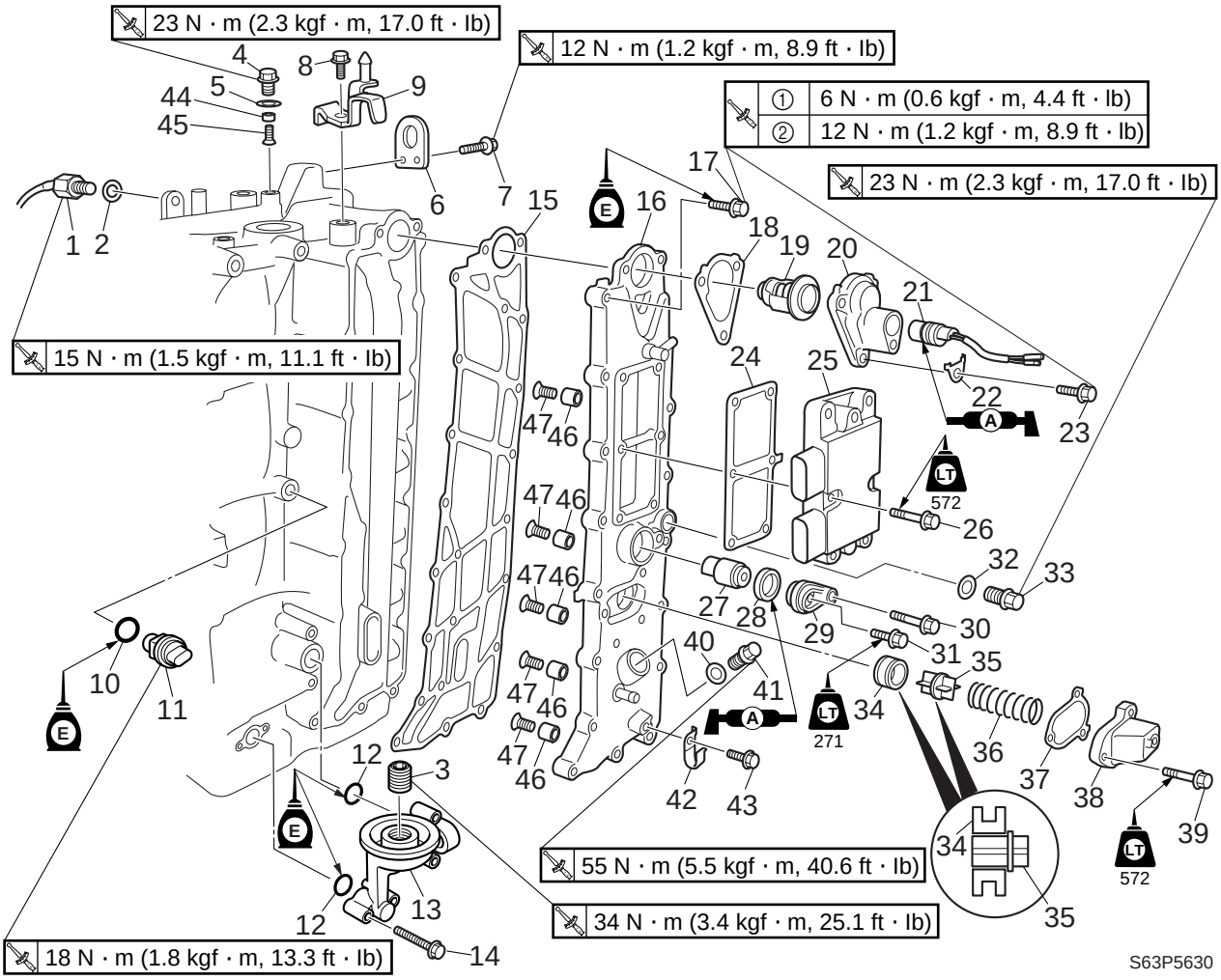
271
S63P5620

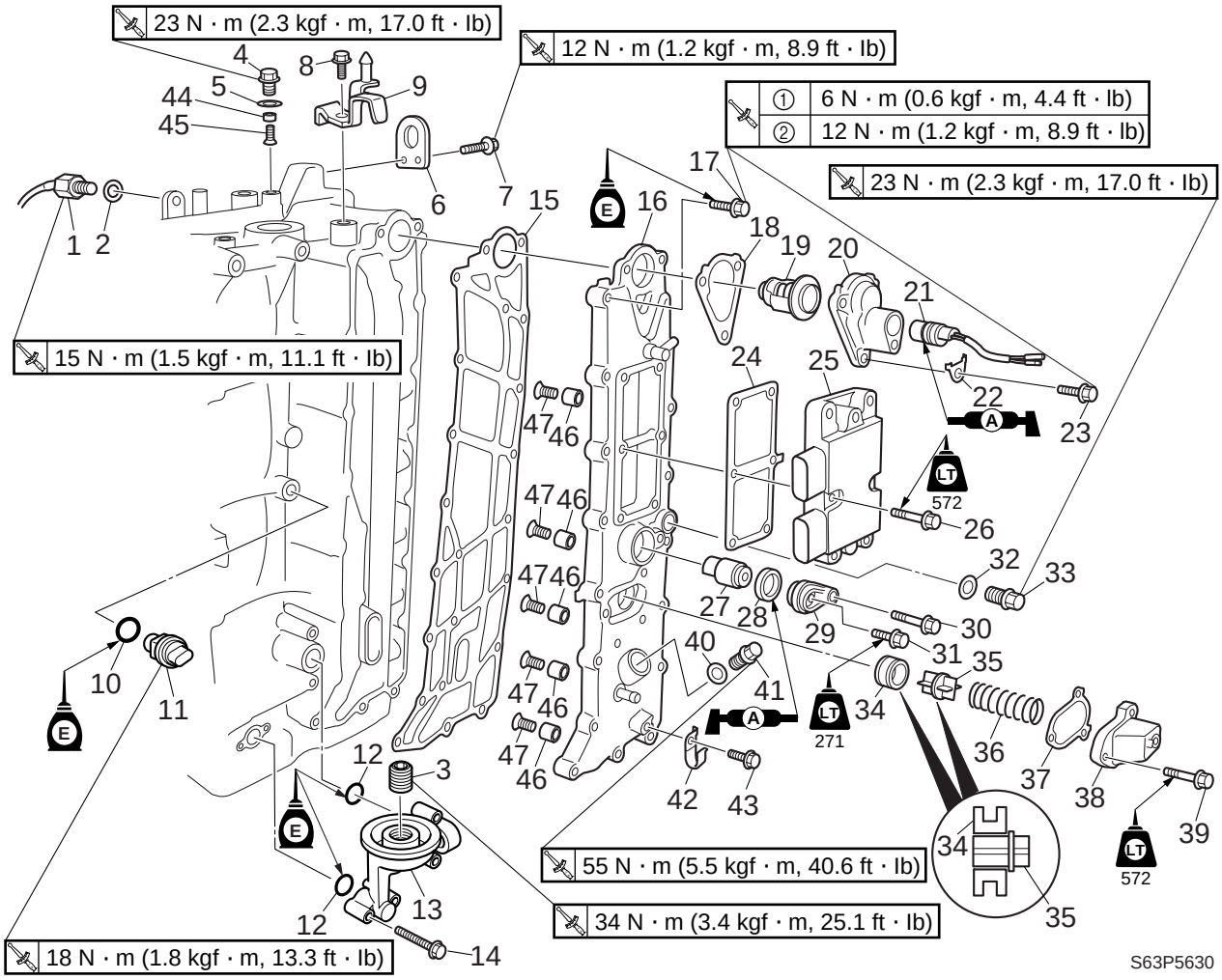
No.	Part name	Q'ty	Remarks
1	Bolt	10	M8 × 55 mm
2	Valve shim	16	
3	Valve lifter	16	
4	Valve cotter	32	
5	Valve spring retainer	16	
6	Valve spring	16	
7	Valve seal	16	**Not reusable**
8	Valve guide	16	**Not reusable**
9	Bolt	10	M10 × 120 mm
10	Spark plug	4	
11	Bolt	2	M8 × 40 mm
12	Bolt	2	M6 × 20 mm
13	Cover	2	
14	Grommet	2	
15	Anode	2	
16	Cylinder head	1	
17	Exhaust valve	8	


25 N · m (2.5 kgf · m, 18.4 ft · lb)
① 14 N · m (1.4 kgf · m, 10.3 ft · lb)
② 28 N · m (2.8 kgf · m, 20.7 ft · lb)
① 19 N · m (1.9 kgf · m, 14.0 ft · lb)
② 37 N · m (3.7 kgf · m, 27.3 ft · lb)
③ 90°
E
A
LT
271
S63P5620

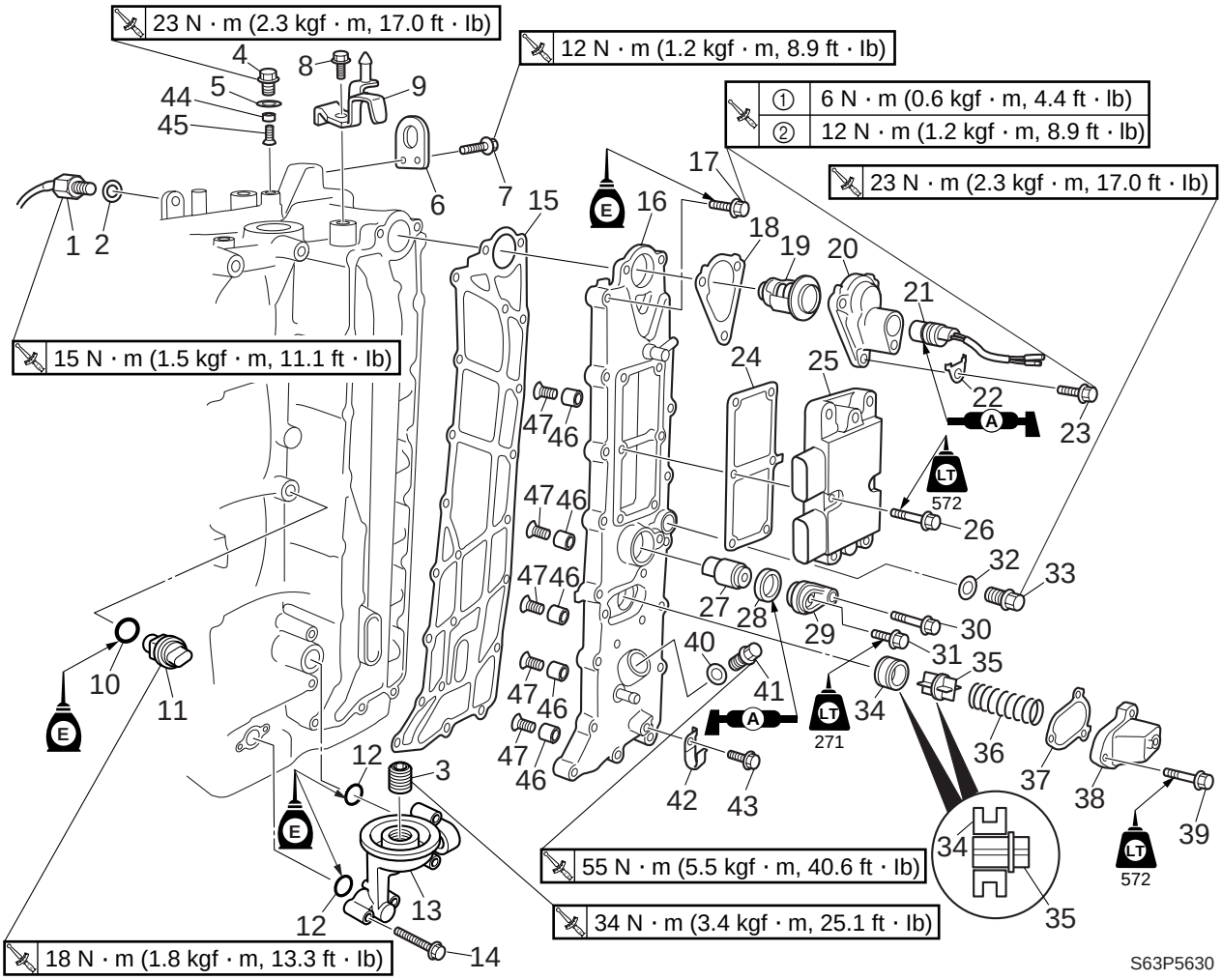
No.	Part name	Q'ty	Remarks
18	Intake valve	8	
19	Gasket	1	**Not reusable**
20	Collar	2	
21	Anode	1	
22	Screw	3	ø6 × 16 mm
23	Anode	2	


23 N · m (2.3 kgf · m, 17.0 ft · lb)
12 N · m (1.2 kgf · m, 8.9 ft · lb)
① 6 N · m (0.6 kgf · m, 4.4 ft · lb)
② 12 N · m (1.2 kgf · m, 8.9 ft · lb)
23 N · m (2.3 kgf · m, 17.0 ft · lb)
15 N · m (1.5 kgf · m, 11.1 ft · lb)
55 N · m (5.5 kgf · m, 40.6 ft · lb)
34 N · m (3.4 kgf · m, 25.1 ft · lb)
18 N · m (1.8 kgf · m, 13.3 ft · lb)
572
271
S63P5630

No.	Part name	Q'ty	Remarks
1	Engine temperature sensor	1	
2	Washer	1	
3	Bolt	1	
4	Plug	1	M14 × 12 mm
5	Washer	1	
6	Engine hanger	1	
7	Bolt	2	M6 × 20 mm
8	Bolt	1	M6 × 16 mm
9	Bracket	1	
10	O-ring	1	**Not reusable**
11	Oil pressure sensor	1	
12	O-ring	2	**Not reusable**
13	Oil filter bracket	1	
14	Bolt	4	M6 × 40 mm
15	Gasket	1	**Not reusable**
16	Exhaust cover	1	
17	Bolt	19	M6 × 30 mm


23 N · m (2.3 kgf · m, 17.0 ft · lb)
12 N · m (1.2 kgf · m, 8.9 ft · lb)
① 6 N · m (0.6 kgf · m, 4.4 ft · lb)
② 12 N · m (1.2 kgf · m, 8.9 ft · lb)
23 N · m (2.3 kgf · m, 17.0 ft · lb)
15 N · m (1.5 kgf · m, 11.1 ft · lb)
55 N · m (5.5 kgf · m, 40.6 ft · lb)
34 N · m (3.4 kgf · m, 25.1 ft · lb)
18 N · m (1.8 kgf · m, 13.3 ft · lb)
572
271
S63P5630

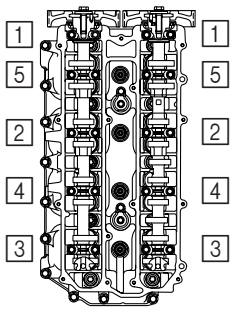
No.	Part name	Q'ty	Remarks
18	Gasket	1	**Not reusable**
19	Thermostat	1	
20	Cover	1	
21	Thermoswitch	1	
22	Holder	1	
23	Bolt	3	M6 × 30 mm
24	Gasket	1	**Not reusable**
25	Rectifier Regulator	1	
26	Bolt	6	M6 × 30 mm
27	Anode	1	
28	Grommet	1	
29	Cover	1	
30	Bolt	1	M8 × 40 mm
31	Bolt	1	M6 × 20 mm
32	Washer	1	
33	Plug	1	M14 × 12 mm
34	Grommet	1	


23 N · m (2.3 kgf · m, 17.0 ft · lb)
12 N · m (1.2 kgf · m, 8.9 ft · lb)
① 6 N · m (0.6 kgf · m, 4.4 ft · lb)
② 12 N · m (1.2 kgf · m, 8.9 ft · lb)
23 N · m (2.3 kgf · m, 17.0 ft · lb)
15 N · m (1.5 kgf · m, 11.1 ft · lb)
55 N · m (5.5 kgf · m, 40.6 ft · lb)
34 N · m (3.4 kgf · m, 25.1 ft · lb)
18 N · m (1.8 kgf · m, 13.3 ft · lb)
572
271
S63P5630

No.	Part name	Q'ty	Remarks
35	Pressure control valve	1	
36	Spring	1	
37	Gasket	1	**Not reusable**
38	Cover	1	
39	Bolt	3	M6 × 20 mm
40	Washer	1	
41	Plug	1	M18 × 17 mm
42	Holder	1	
43	Bolt	1	M6 × 12 mm
44	Anode	1	
45	Screw	1	
46	Anode	7	
47	Screw	7	ø5 × 27 mm

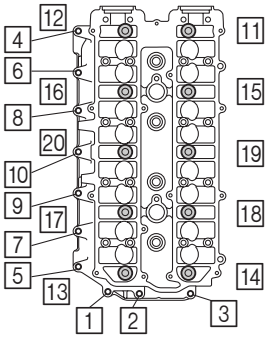
Removing the cylinder head

1. Remove the camshaft caps in the sequence shown.



S63P5100

2. Remove the camshafts and cylinder head bolts in the sequence shown.

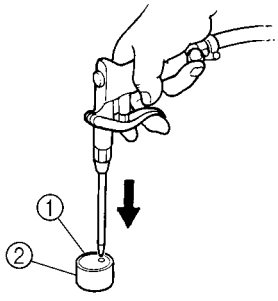


S63P5170

CAUTION:

Do not scratch or damage the mating surfaces of the cylinder head and cylinder block.

3. Remove the valve shim ① from the valve lifter ② using compressed air.

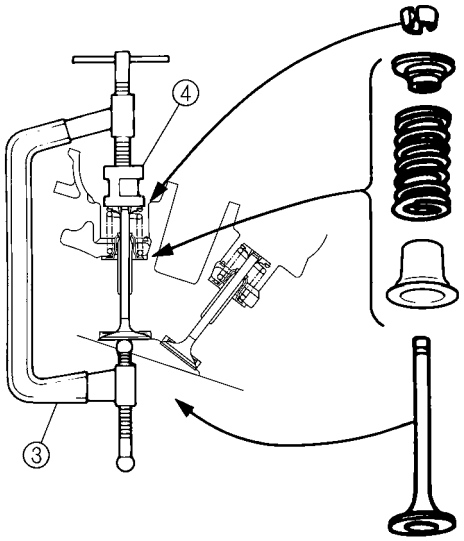


S63P5510

NOTE:

Do not mix the valve train parts. Keep them organized in their proper groups.

4. Remove the intake valve and exhaust valves.



S63P5520

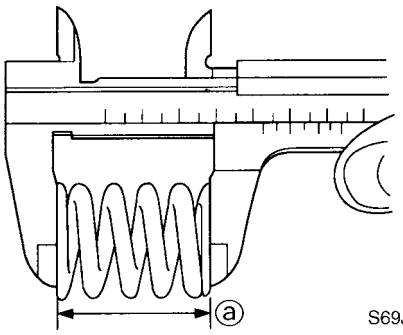
NOTE:

Be sure to keep the valves, springs, and other parts in the order as they were removed.

Valve spring compressor ③:
90890-04019
Valve spring compressor attachment ④:
90890-06320

Checking the valve springs

1. Measure the valve spring free length ⓐ. Replace if out of specification.

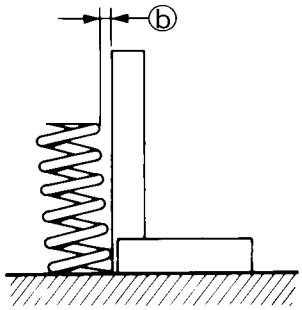


S69J5720

Valve spring free length ⓐ:
44.20 mm (1.7402 in)

5

2. Measure the valve spring tilt ⓑ. Replace if out of specification.



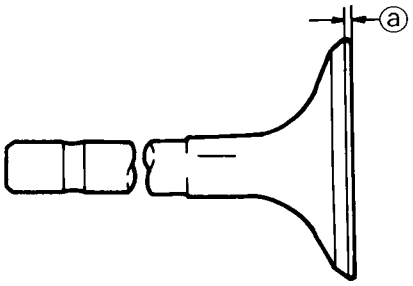
S69J5730

Valve spring tilt limit ⓑ:
1.5 mm (0.06 in)

Checking the valves

1. Check the valve face for pitting or wear. Replace if necessary.

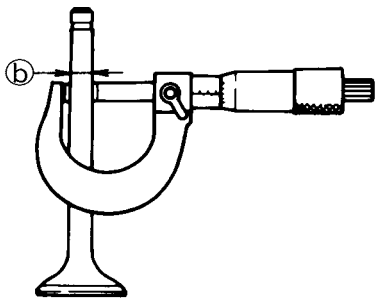
2. Measure the valve margin thickness ⓐ. Replace if out of specification.



S69J5740

Valve margin thickness ⓐ:
Intake: 0.70 mm (0.0276 in)
Exhaust: 1.00 mm (0.0394 in)

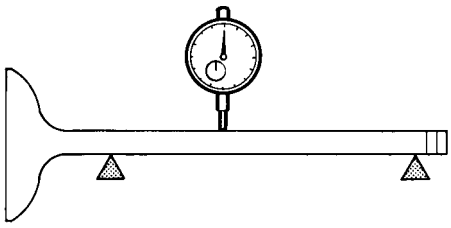
3. Measure the valve stem diameter ⓑ. Replace if out of specification.



S69J5750

Valve stem diameter ⓑ:
Intake:
5.477–5.492 mm
(0.2156–0.2162 in)
Exhaust:
5.464–5.479 mm
(0.2151–0.2157 in)

4. Measure the valve stem runout. Replace if out of specification.

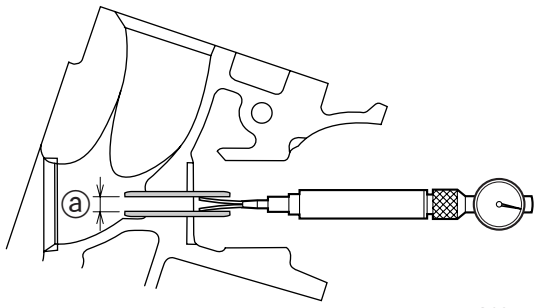

S69J5760

Valve stem runout:
0.01 mm (0.0004 in)

Checking the valve guides

NOTE:
Before checking the valve guide make sure that the valve stem diameter is within specification.

1. Measure the valve guide inside diameter ⓐ.



S69J5770

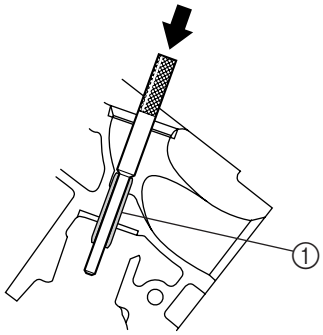
Valve guide inside diameter ⓐ:
5.504–5.522 mm
(0.2167–0.2174 in)

2. Calculate the valve stem-to-valve guide clearance as follows. Replace the valve guide if out of specification.

Valve stem-to-valve guide clearance = valve guide inside diameter – valve stem diameter:
Intake and exhaust:
0.025–0.058 mm
(0.0010–0.0023 in)

Replacing the valve guides

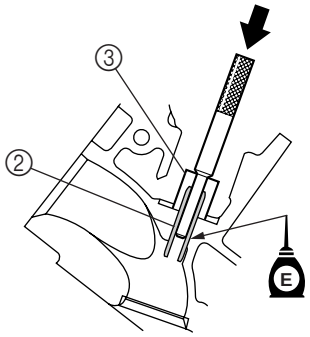
1. Remove the valve guide ① by striking the special service tool from the combustion chamber side.



S69J5790

Valve guide remover/installer:
90890-06801

2. Install a new valve guide ② by striking the special service tool from the camshaft side until the valve guide installer ③ contacts the cylinder head.

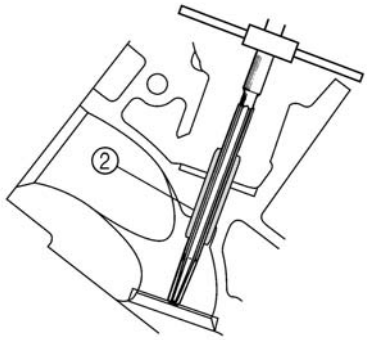


S69J5800

NOTE:
Apply engine oil to the surface of the new valve guide.

Valve guide remover/installer:
90890-06801
Valve guide installer: 90890-06810

3. Insert the special service tool into the valve guide ②, and then ream the valve guide.



S69J5810

NOTE:
- Turn the valve guide reamer clockwise to ream the valve guide.
- Do not turn the reamer counterclockwise when removing the reamer.

Valve guide reamer: 90890-06804

4. Measure the valve guide inside diameter.

Valve guide inside diameter:
5.504–5.522 mm
(0.2167–0.2174 in)

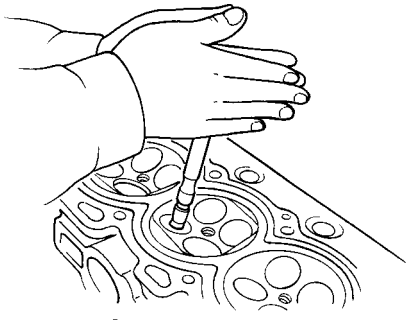
5

Checking the valve seat

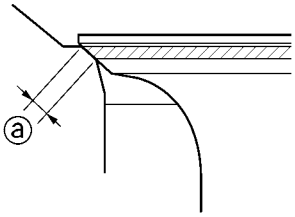
1. Eliminate carbon deposits from the valve with a scraper.

2. Apply a thin, even layer of Mechanic's blueing dye (Dykem) onto the valve seat.

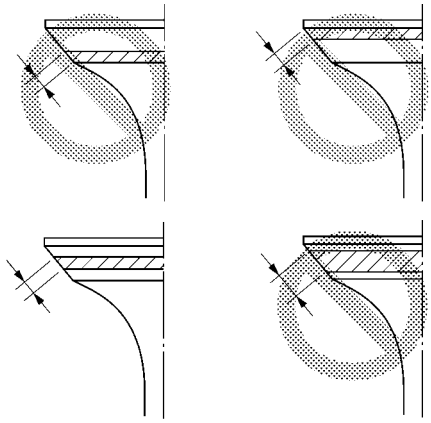
3. Lap the valve slowly on the valve seat with a valve lapper (commercially available) as shown.


S69J5820

4. Measure the valve seat contact width ⓐ where the blueing dye is adhered to the valve face. Reface the valve seat if the valve is not seated properly or if the valve seat contact width is out of specification. Replace the valve guide if the valve seat contact is uneven.



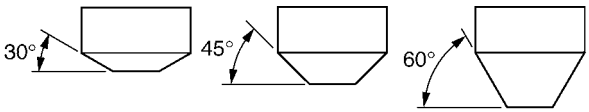
S69J5830


S69J5840

Valve seat contact width ⓐ:
Intake:
1.1–1.4 mm (0.043–0.055 in)
Exhaust:
1.4–1.7 mm (0.055–0.067 in)

Refacing the valve seat

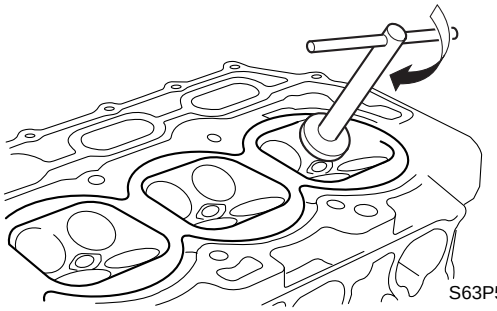
1. Reface the valve seat with the valve seat cutter.

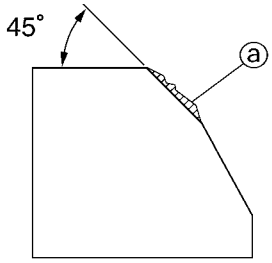


S69J5850

Valve seat cutter holder:
90890-06316
Valve seat cutter:
30° (intake): 90890-06327
30° (exhaust): 90890-06326
45° (intake and exhaust):
90890-06325
60° (intake and exhaust):
90890-06324

2. Cut the surface of the valve seat with a 45° cutter by turning the cutter clockwise until the valve seat face has become smooth.


S63P5240



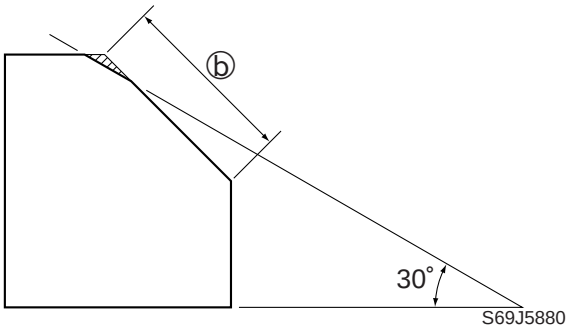
S69J5870

ⓐ Slag or rough surface

CAUTION:

Do not over cut the valve seat. Be sure to turn the cutter evenly downward at a pressure of 40–50 N (4–5 kgf, 8.8–11 lbf) to prevent chatter marks.

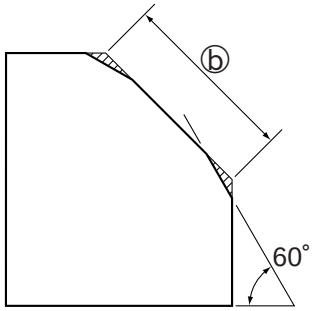
3. Use a 30° cutter to adjust the contact width of the top edge of the valve seat.



S69J5880

ⓑ Previous contact width

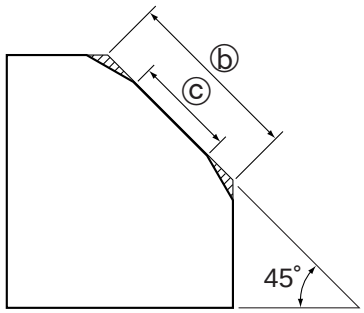
4. Use a 60° cutter to adjust the contact width of the bottom edge of the valve seat.



S69J5890

ⓑ Previous contact width

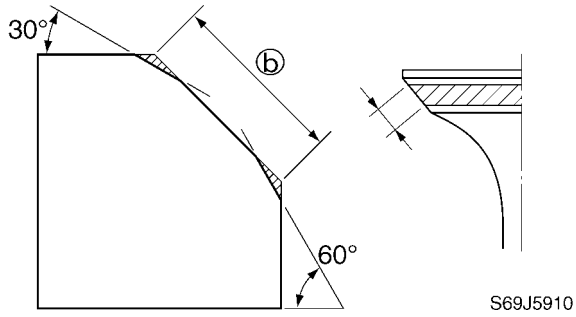
5. Use a 45° cutter to adjust the contact width of the valve seat to specification.



S69J5900

ⓑ Previous contact width
ⓒ Specified contact width

6. If the valve seat contact area is too wide and situated in the center of the valve face, use a 30° cutter to cut the top edge of the valve seat, a 60° cutter to cut the bottom edge to center the area and set its width.

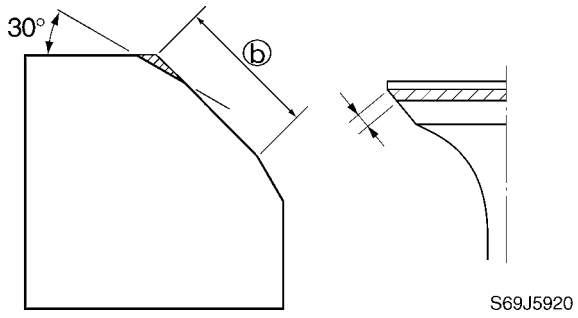


S69J5910

ⓑ Previous contact width

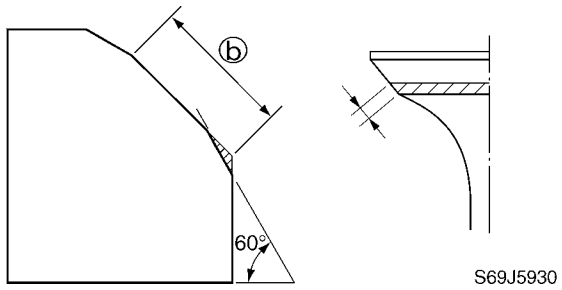
5

7. If the valve seat contact area is too narrow and situated near the top edge of the valve face, use a 30° cutter to cut the top edge of the valve seat. If necessary, use a 45° cutter to center the area and set its width.



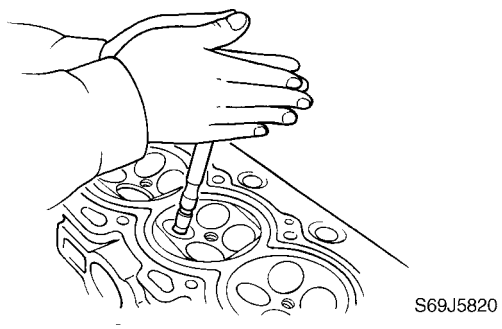
ⓑ Previous contact width

8. If the valve seat contact area is too narrow and situated near the bottom edge of the valve face, use a 60° cutter to cut the bottom edge of the valve seat. If necessary, use a 45° cutter to center the area and set its width.



ⓑ Previous contact width

9. Apply a thin, even layer of lapping compound onto the valve seat, and then lap the valve using a valve lapper (commercially available).



CAUTION:

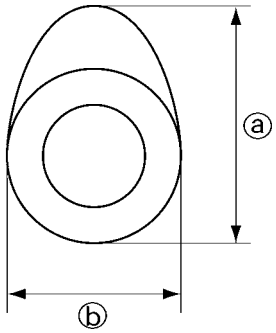
Do not get the lapping compound on the valve stem and valve guide.

10. After every lapping procedure, be sure to clean off any remaining lapping compound from the cylinder head and the valve.

11. Check the valve seat contact area of the valve again.

Checking the camshaft

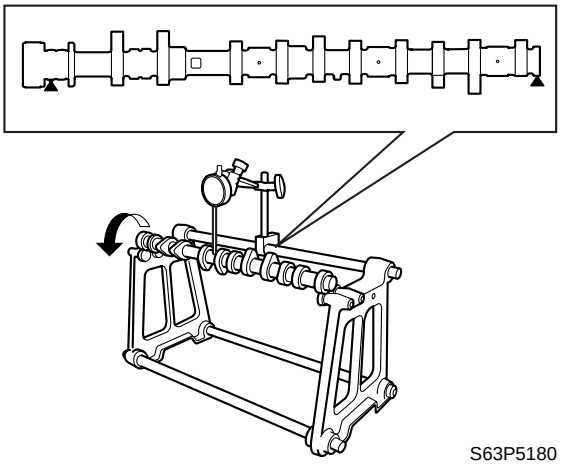
1. Measure the cam lobe. Replace if out of specification.



Cam lobe ⓐ:
- Intake:
  - 45.300–45.400 mm
  - (1.7835–1.7874 in)
- Exhaust:
  - 44.350–44.450 mm
  - (1.7461–1.7500 in)

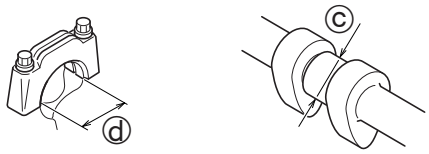
Cam lobe ⓑ:
- Intake and exhaust:
  - 35.950–36.050 mm
  - (1.4154–1.4193 in)

2. Measure the camshaft runout. Replace if out of specification.


S63P5180

Camshaft runout limit:
0.03 mm (0.0012 in)

3. Measure the camshaft journal diameter ⓒ and cylinder head journal inside diameter ⓓ. Replace the camshaft and cylinder head if out of specification.


S69J5970

Camshaft journal diameter ⓒ:
24.960–24.980 mm
(0.9827–0.9835 in)
Camshaft cap inside diameter ⓓ:
25.000–25.021 mm
(0.9843–0.9851 in)

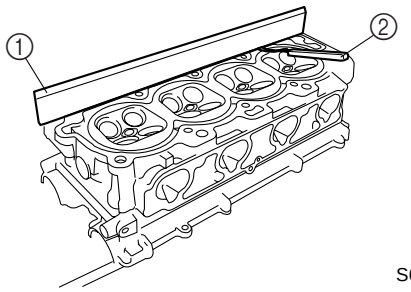
4. Calculate the camshaft oil clearance ⓔ as follows. Replace the camshaft and cylinder head as a set if out of specification.

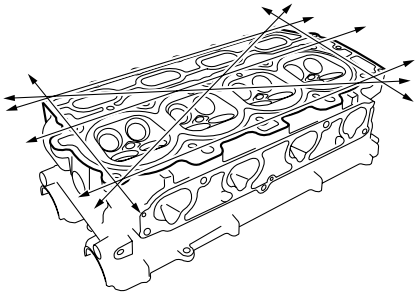
Camshaft oil clearance ⓔ =
Camshaft cap inside diameter ⓓ –
Camshaft journal diameter ⓒ:
0.020–0.060 mm
(0.0008–0.0024 in)

Checking the cylinder head

1. Eliminate carbon deposits from the combustion chambers and check for deterioration.

2. Check the cylinder head warpage using a straightedge ① and thickness gauge ② in seven directions as shown. Replace if out of specification.

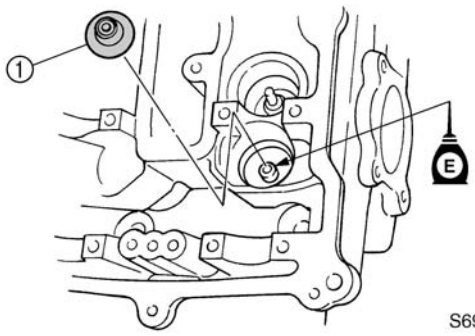

S63P5190


S63P5200

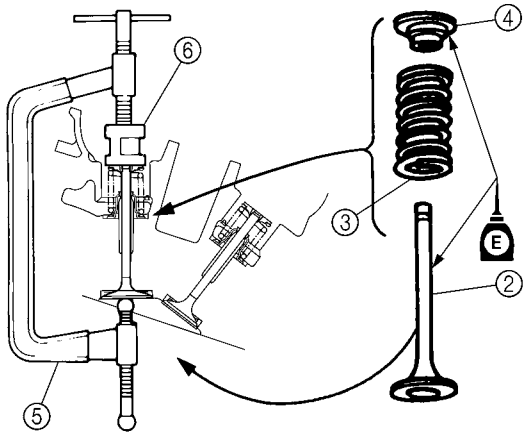
Cylinder head warpage limit:
0.10 mm (0.0039 in)

Installing the valves

1. Install a new valve seal ① into the valve guide.


S69J5A20

2. Install the valve ②, valve spring ③, and valve spring retainer ④ in the sequence shown, and then attach the special service tool.

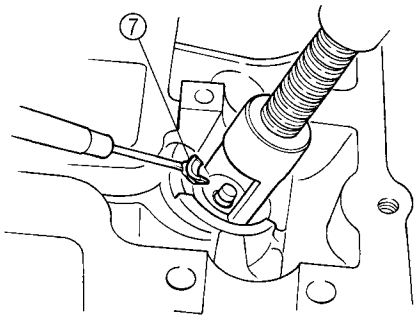


S69J5A30

NOTE:
The valve spring can be installed in any direction.

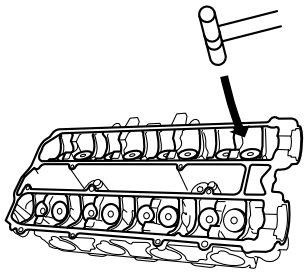
Valve spring compressor ⑤:
90890-04019
Valve spring compressor attachment ⑥:
90890-06320

3. Compress the valve spring, and then install the valve cotter ⑦ using a thin screwdriver with a small amount of grease applied to it.



S69J5A40

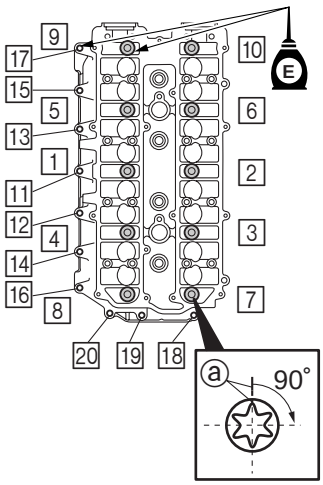
4. Lightly tap the valve spring retainer with a plastic hammer to set the valve cotter securely.


S63P5210

NOTE:
Apply engine oil to the valve shims and valve lifters before installation.

Installing the cylinder head

1. Install a new gasket and the cylinder head, and then tighten the bolts to the specified torques in the sequence shown.



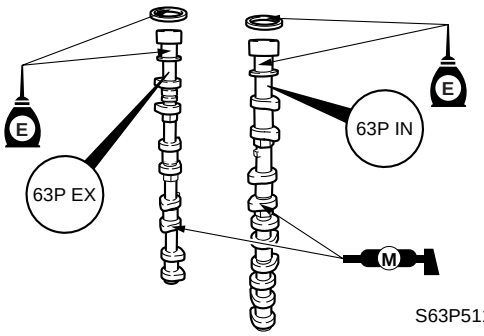
S63P5220

CAUTION:
Do not reuse the cylinder head gasket, always replace it with a new one.

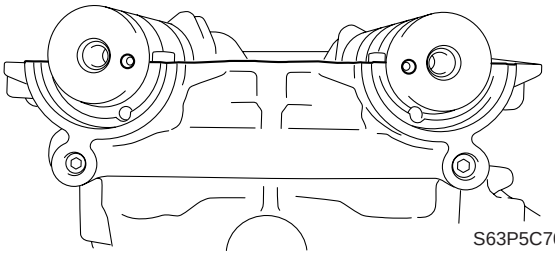
NOTE:
- Apply engine oil to the cylinder head bolts before installation.
- Tighten the M10 bolts to the specified torques in two stages first, and then make a mark ⓐ on the M10 bolts and the cylinder head, and then tighten the bolts 90° from the mark.
- Tighten the M8 bolts to the specified torques in two stages.

Cylinder head bolt (M10):
1st: 19 N·m (1.9 kgf·m, 14.0 ft·lb)
2nd: 37 N·m (3.7 kgf·m, 27.3 ft·lb)
3rd: 90°
Cylinder head bolt (M8):
1st: 14 N·m (1.4 kgf·m, 10.3 ft·lb)
2nd: 28 N·m (2.8 kgf·m, 20.7 ft·lb)

2. Install the camshafts into the cylinder head with new oil seals.

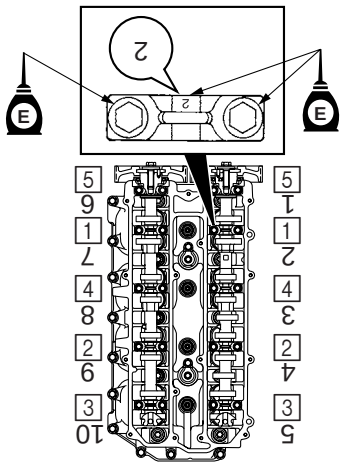


S63P5110


S63P5C70

NOTE:
Install the camshafts so that the dowels are facing inward and that they are aligned with the mating surface of the cylinder head.

3. Install the camshaft caps, and then tighten the bolts to the specified torques in two stages and in the sequence shown.



S63P5120

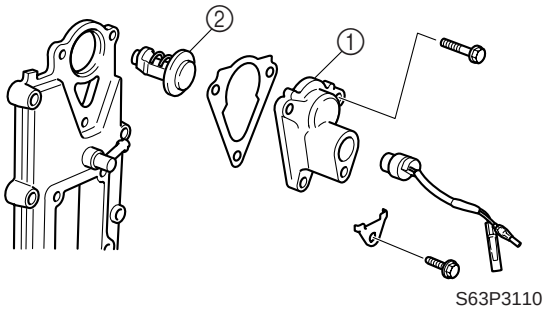
NOTE:
- Install the camshaft caps in the proper position as shown and with the stamped numbers facing upside down.
- Apply engine oil to the camshaft cap bolts before installation.

Camshaft cap bolt:
1st: 8 N·m (0.8 kgf·m, 5.9 ft·lb)
2nd: 17 N·m (1.7 kgf·m, 12.5 ft·lb)

5

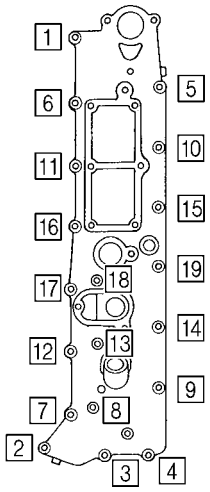
Removing the exhaust cover

1. Remove the cover ① and thermostat ②.



S63P3110

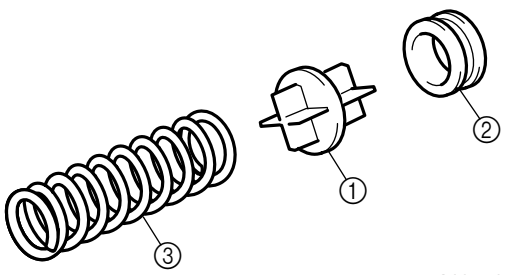
2. Remove the exhaust cover bolts in the sequence shown.



S63P5660

Checking the pressure control valve

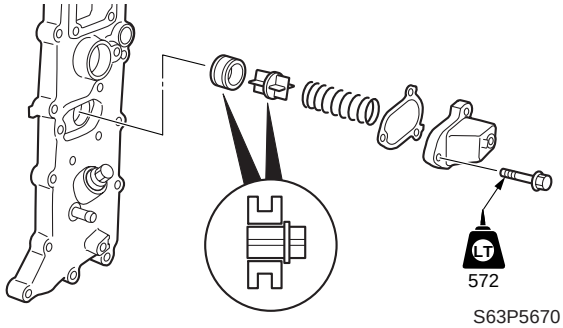
1. Remove the pressure control valve.
2. Check the pressure control valve ① for wear or damage. Replace if necessary.
3. Check the grommet ② for deformation. Replace if necessary.
4. Check the spring ③ for fatigue or deformation. Replace if necessary.



S60V5610

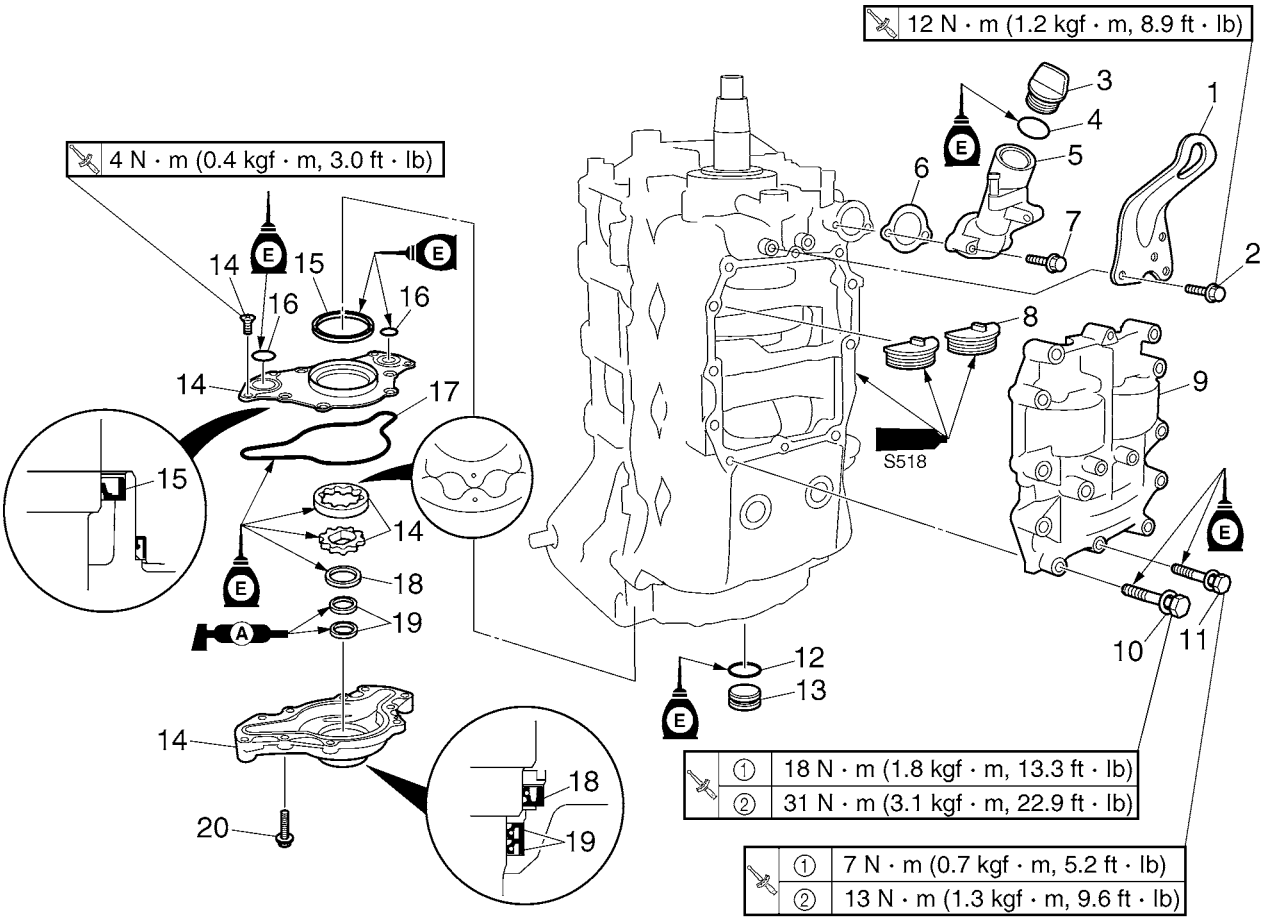
Installing the pressure control valve

1. Install a new gasket and the pressure control valve, and then tighten the bolts.



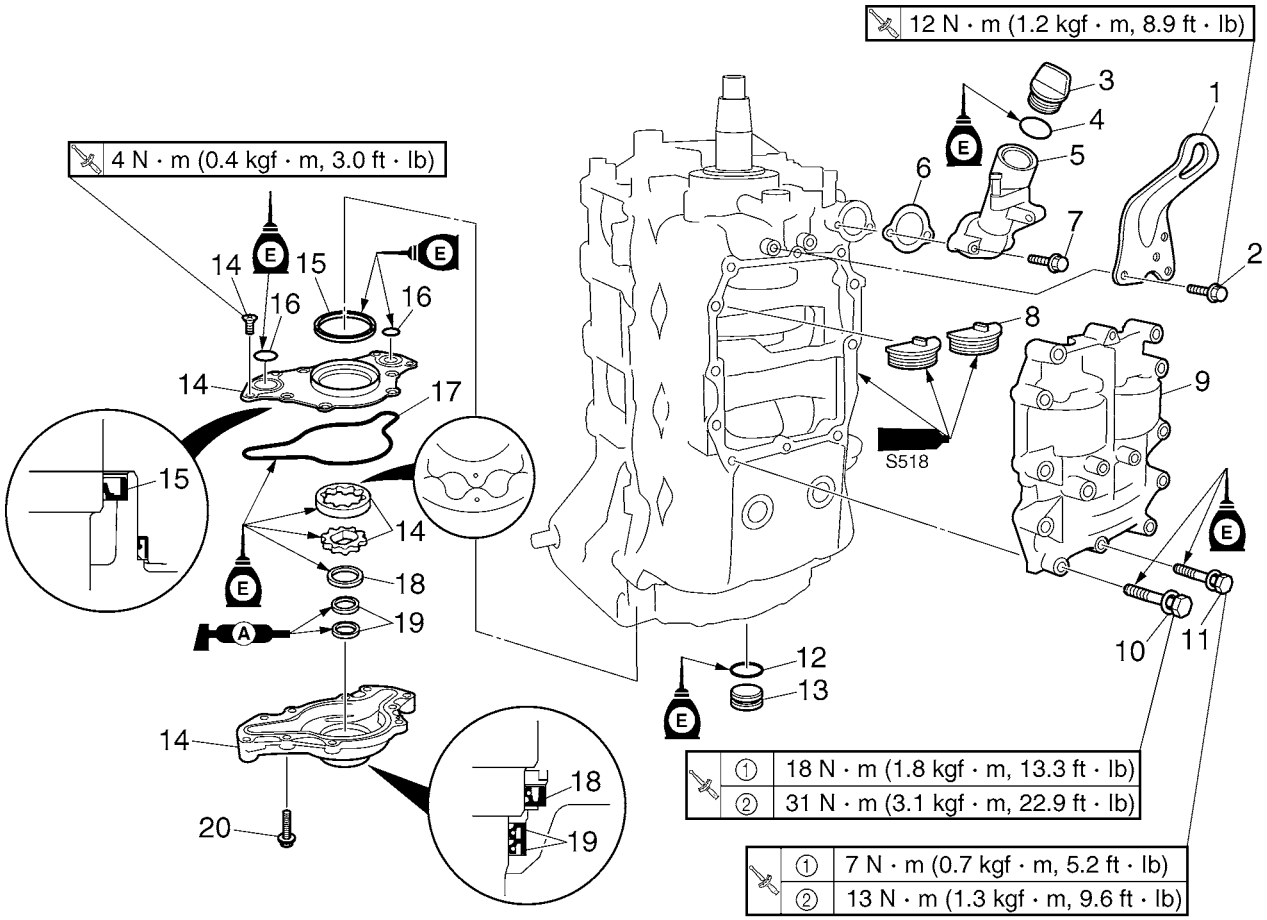
S63P5670

Cylinder block


12 N · m (1.2 kgf · m, 8.9 ft · lb)
4 N · m (0.4 kgf · m, 3.0 ft · lb)
S518
① 18 N · m (1.8 kgf · m, 13.3 ft · lb)
② 31 N · m (3.1 kgf · m, 22.9 ft · lb)
① 7 N · m (0.7 kgf · m, 5.2 ft · lb)
② 13 N · m (1.3 kgf · m, 9.6 ft · lb)

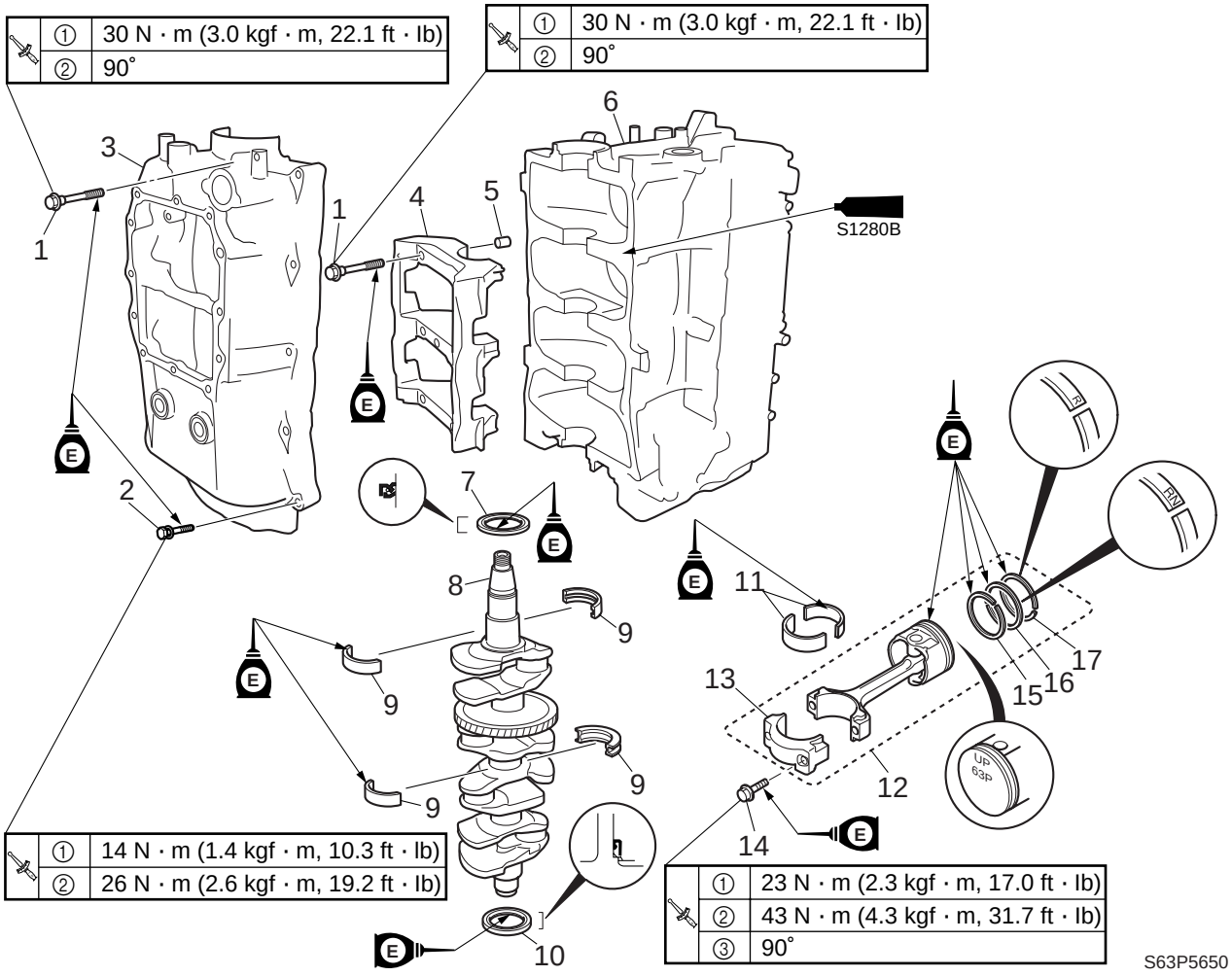
S63P5640

No.	Part name	Q'ty	Remarks
1	Engine hanger	1	
2	Bolt	3	M6 × 20 mm
3	Oil filler cap	1	
4	O-ring	1	
5	Oil filler neck	1	
6	Gasket	1	**Not reusable**
7	Bolt	2	M6 × 45 mm
8	Seal	2	**Not reusable**
9	Balancer assembly	1	
10	Bolt	10	M8 × 55 mm
11	Bolt	2	M6 × 40 mm
12	O-ring	1	**Not reusable**
13	Plug	1	
14	Oil pump assembly	1	
15	Oil seal	1	**Not reusable**
16	O-ring	2	**Not reusable**
17	Gasket	1	**Not reusable**


12 N · m (1.2 kgf · m, 8.9 ft · lb)
4 N · m (0.4 kgf · m, 3.0 ft · lb)
S518
① 18 N · m (1.8 kgf · m, 13.3 ft · lb)
② 31 N · m (3.1 kgf · m, 22.9 ft · lb)
① 7 N · m (0.7 kgf · m, 5.2 ft · lb)
② 13 N · m (1.3 kgf · m, 9.6 ft · lb)

S63P5640

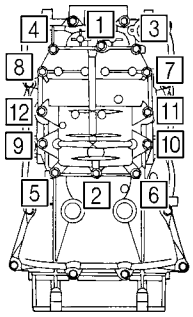
No.	Part name	Q'ty	Remarks
18	Oil seal	1	**Not reusable**
19	Oil seal	2	**Not reusable**
20	Bolt	4	M6 × 40 mm



No.	Part name	Q'ty	Remarks
1	Bolt	10	M10 × 85 mm
2	Bolt	10	M8 × 55 mm
3	Crankcase	1	
4	Main bearing cap	1	
5	Collar	10	
6	Cylinder block	1	
7	Oil seal	1	**Not reusable**
8	Crankshaft	1	
9	Main bearing	10	
10	Oil seal	1	**Not reusable**
11	Connecting rod bearing	8	
12	Piston/connecting rod assembly	4	
13	Connecting rod cap	4	
14	Bolt	8	**Not reusable**
15	Oil ring	4	
16	2nd piston ring	4	
17	Top ring	4	

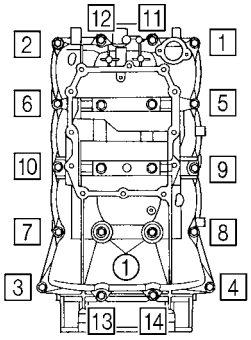
Disassembling the cylinder block

1. Remove the oil pump.
2. Remove the balancer bolts in the sequence shown.



S63P5680

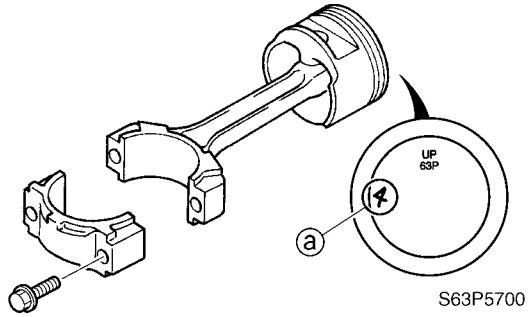
3. Remove the crankcase bolts in the sequence shown.



S63P5690

NOTE:
Do not remove the plugs ① from the crankcase.

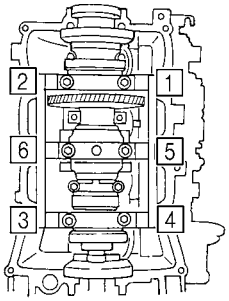
4. Remove the connecting rod bolts and the connecting rod caps, and then remove the connecting rod and piston assemblies.



S63P5700

NOTE:
- Be sure to keep the bearings in the order as they were removed.
- Mark each piston with an identification number ⓐ of the corresponding cylinder.
- Do not mix the connecting rods and caps. Keep them organized in their proper groups.

5. Remove the main bearing cap bolts in the sequence shown.

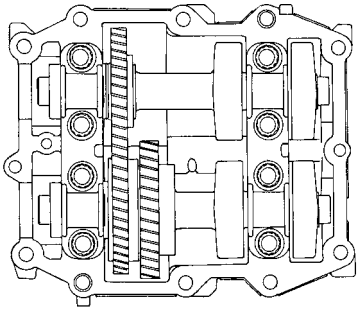


S63P5710

6. Remove the crankshaft.

Checking the balancer assembly

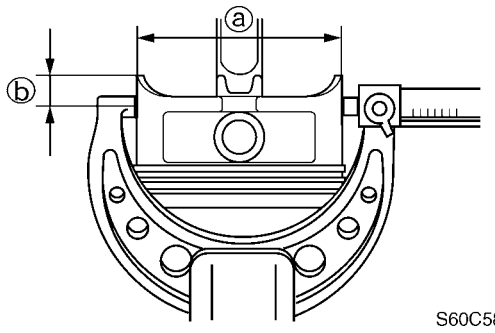
1. Check the teeth of the balancer shaft gear for cracks or wear. Replace the balancer assembly if necessary.



S63P5C20

Checking the piston diameter

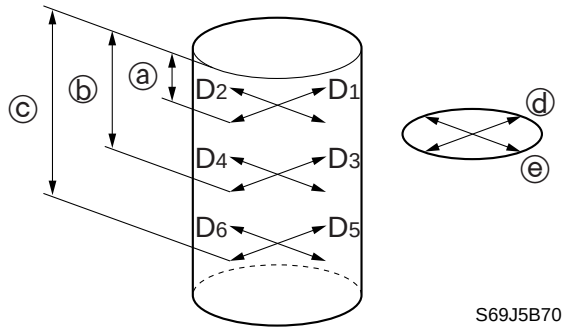
1. Measure the piston outside diameter at the specified measuring point. Replace if out of specification.



Piston diameter ⓐ:
93.928–93.934 mm
(3.6979–3.6982 in)
Measuring point ⓑ:
5.0 mm (0.20 in) up from the bottom of the piston skirt

Checking the cylinder bore

1. Measure the cylinder bore (D_1–D_6) at measuring points ⓐ, ⓑ, and ⓒ, and in direction ⓓ (D_1, D_3, D_5), which is parallel to the crankshaft, and direction ⓔ (D_2, D_4, D_6), which is at a right angle to the crankshaft.



ⓐ 20 mm (0.8 in)
ⓑ 60 mm (2.4 in)
ⓒ 100 mm (3.9 in)

Cylinder bore (D_1–D_6):
94.000–94.017 mm
(3.7008–3.7014 in)

2. Calculate the taper limit. Replace the cylinder block if out of specification.

Taper limit:
D_1–D_5 (direction ⓓ)
D_2–D_6 (direction ⓔ)
0.08 mm (0.0032 in)

3. Calculate the out-of-round limit. Replace the cylinder block if out of specification.

Out-of-round limit:
D_2–D_1 (measuring point ⓐ)
D_6–D_5 (measuring point ⓒ)
0.05 mm (0.0020 in)

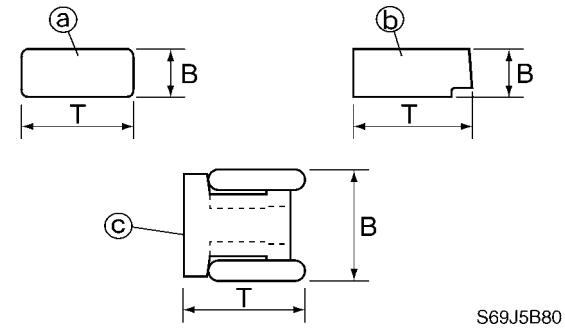
Checking the piston clearance

1. Replace the piston and piston rings as a set, or the cylinder block, or all parts if out of specification.

Piston clearance:
0.075–0.080 mm
(0.0030–0.0031 in)

Checking the piston rings

1. Check the piston ring dimensions of B and T. Replace if out of specification.

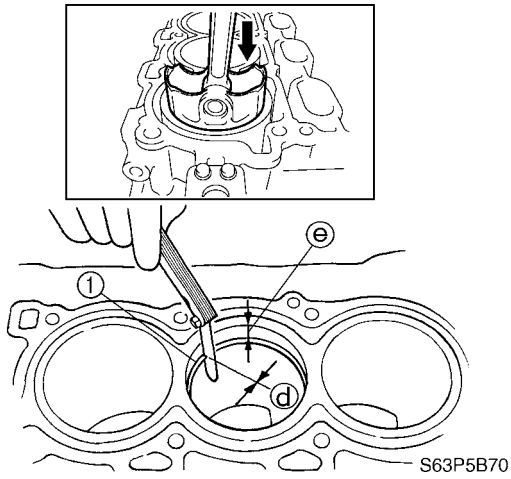


Piston ring dimensions:
Top ring ⓐ:
B: 1.17–1.19 mm
(0.0461–0.0469 in)
T: 2.80–3.00 mm
(0.1102–0.1181 in)
Second ring ⓑ:
B: 1.17–1.19 mm
(0.0461–0.0469 in)
T: 3.70–3.90 mm
(0.1457–0.1535 in)
Oil ring ⓒ:
B: 2.40–2.47 mm
(0.0945–0.0972 in)
T: 2.30–2.70 mm
(0.0906–0.1063 in)

5

2. Level the piston ring ① in the cylinder with a piston crown.

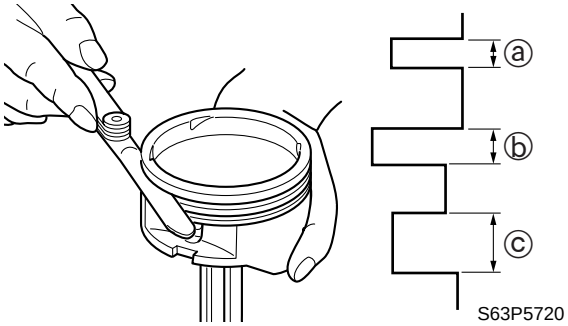
3. Check the piston ring end gap ⓓ at the specified measuring point. Replace if out of specification.



Piston ring end gap ⓓ:
Top ring:
0.15–0.30 mm
(0.0059–0.0118 in)
Second ring:
0.30–0.45 mm
(0.0118–0.0177 in)
Oil ring:
0.15–0.60 mm
(0.0059–0.0236 in)
Measuring point ⓔ: 20 mm (0.8 in)

Checking the piston ring grooves

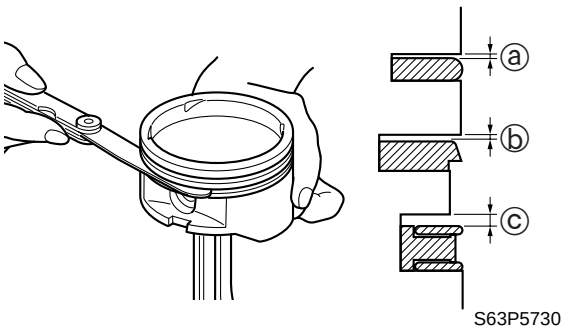
1. Measure the piston ring grooves. Replace the piston if out of specification.



Piston ring groove:
Top ring ⓐ:
1.23–1.25 mm (0.048–0.049 in)
Second ring ⓑ:
1.22–1.24 mm (0.048–0.049 in)
Oil ring ⓒ:
2.51–2.53 mm (0.099–0.100 in)

Checking the piston ring side clearance

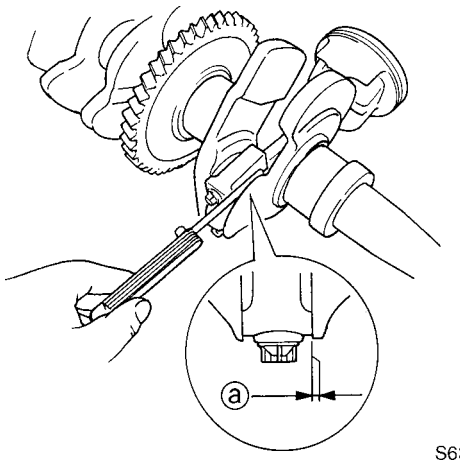
1. Measure the piston ring side clearance. Replace the piston and piston rings as a set if out of specification.



Piston ring side clearance:
Top ring ⓐ:
0.04–0.08 mm
(0.0016–0.0031 in)
Second ring ⓑ:
0.03–0.07 mm
(0.0012–0.0028 in)
Oil ring ⓒ:
0.04–0.13 mm
(0.0016–0.0051 in)

Checking the connecting rod big end side clearance

1. Measure the connecting rod big end side clearance ⓐ. Replace the connecting rod or crankshaft, or both if out of specification.

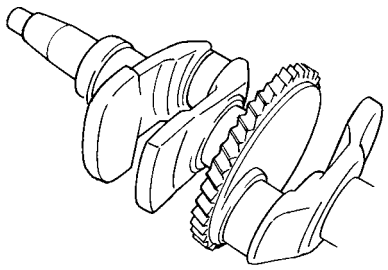


S63P5740

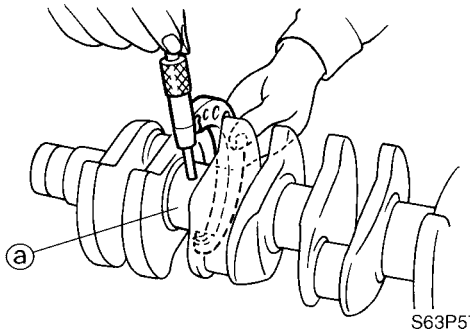
Connecting rod big end side clearance ⓐ:
0.14–0.31 mm (0.006–0.012 in)

Checking the crankshaft

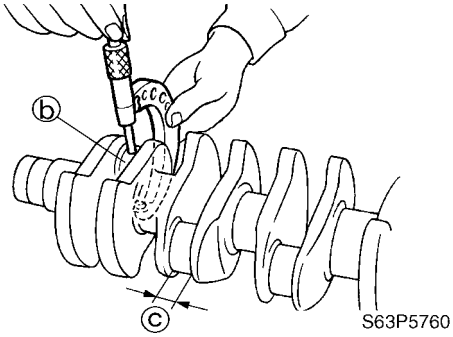
1. Check the teeth of the crankshaft gear for cracks or wear. Replace the crankshaft if necessary.


S63P5C30

2. Measure the crankshaft journal diameter ⓐ, crankpin diameter ⓑ, and crankpin width ⓒ. Replace the crankshaft if out of specification.



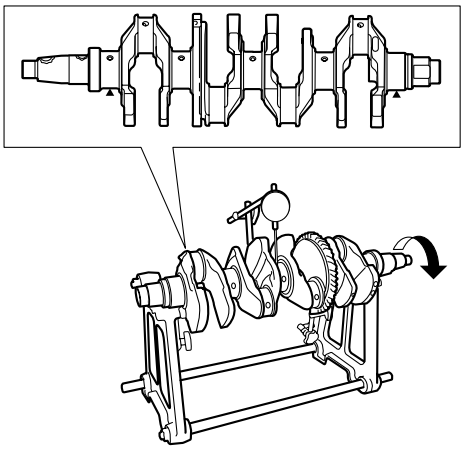
S63P5750



S63P5760

Crankshaft journal diameter ⓐ:
51.980–52.000 mm
(2.0465–2.0472 in)
Crankpin diameter ⓑ:
49.980–50.000 mm
(1.9677–1.9685 in)
Crankpin width ⓒ:
22.00–22.10 mm
(0.8661–0.8701 in)

3. Measure the crankshaft runout. Replace the crankshaft if out of specification.


S63P5550

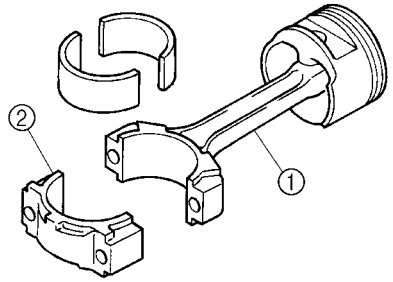
Crankshaft runout limit:
0.03 mm (0.0012 in)

5

Checking the crankpin oil clearance

1. Clean the bearings and the connecting rod.

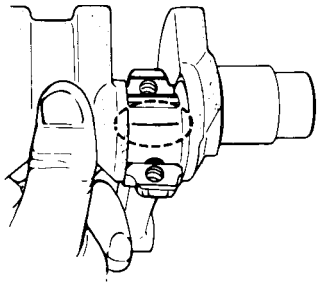
2. Install the upper bearing into the connecting rod ① and the lower bearing into the connecting rod cap ②.



S63P5770

NOTE:
Install the connecting rod bearings in their original positions.

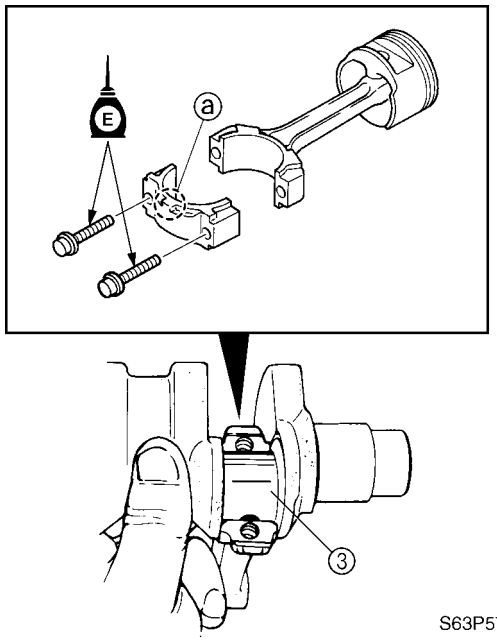
3. Put a piece of Plastigauge (PG-1) onto the crankpin, parallel to the crankshaft.



S69J5D00

NOTE:
Be sure not to put the Plastigauge (PG-1) over the oil hole in the crankpin of the crankshaft.

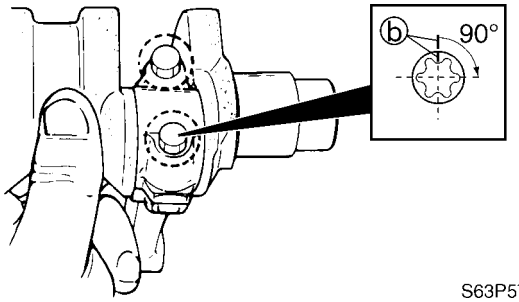
4. Install the connecting rod to the crankpin ③.



S63P5780

NOTE:
Make sure that the mark ⓐ of the connecting rod faces towards the flywheel magnet side of the crankshaft.

5. Tighten the connecting rod bolts to the specified torques in three stages.

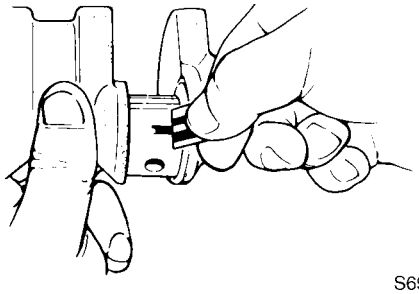


S63P5790

NOTE:
- Reuse the removed connecting rod bolts when checking the oil clearance.
- Do not turn the connecting rod until the crankpin oil clearance measurement has been completed.
- Make a mark ⓑ on the connecting rod bolts, connecting rod caps, and then tighten the bolts 90° from the mark.

Connecting rod bolt:
1st: 23 N·m (2.3 kgf·m, 17.0 ft·lb)
2nd: 43 N·m (4.3 kgf·m, 31.7 ft·lb)
3rd: 90°

6. Remove the connecting rod cap and measure the width of the compressed Plastigauge (PG-1) on each crankpin. Replace the connecting rod bearing if out of specification.



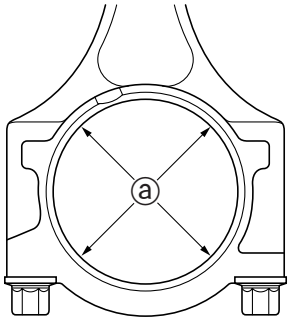
S69J5D30

Crankpin oil clearance:
0.027–0.052 mm
(0.0011–0.0020 in)

Selecting the connecting rod bearing

1. When replacing the connecting rod bearing, select the suitable bearing as follows.

2. Measure the connecting rod big end inside diameter ⓐ.



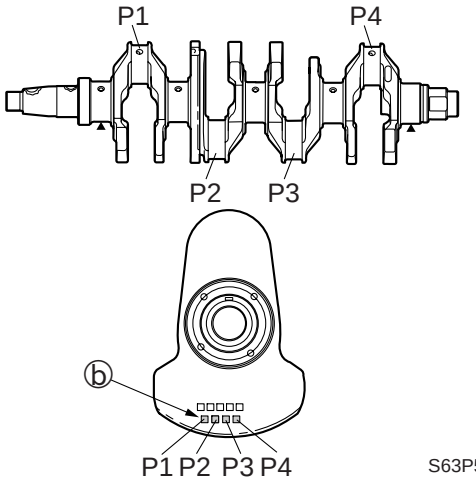
S60C5980

NOTE:
Reuse the connecting rod bolts.

Example:

Connecting rod big end inside diameter ⓐ	Numerical value in table
53.035 mm	35

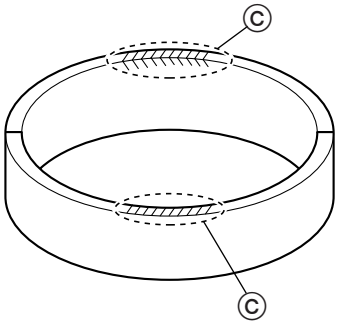
3. Check the crankpin mark ⓑ on the crankshaft.



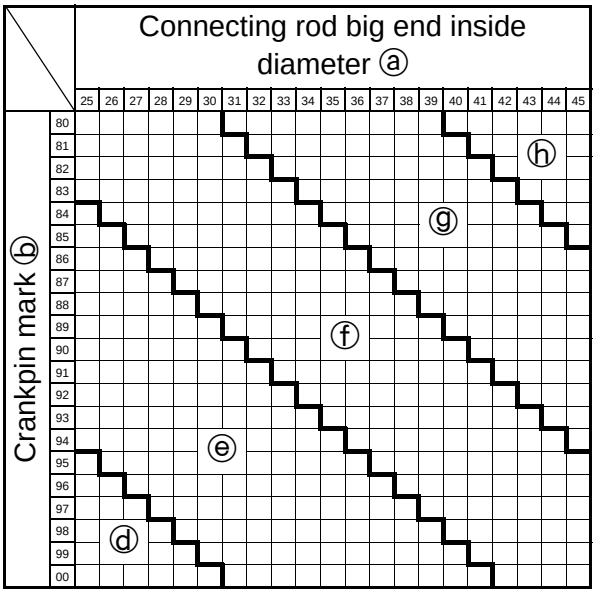
S63P5530

5

4. Select the suitable color ⓒ for the connecting rod bearing from the table.



S63P5800



	Upper bearing color	Lower bearing color
ⓓ	Green	Green
ⓔ	Green	Blue
ⓕ	Blue	Blue
ⓖ	Blue	Red
ⓗ	Red	Red

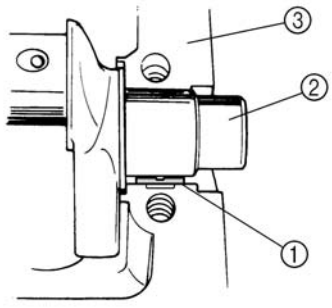
NOTE:
- Example: If the connecting rod big end inside diameter ⓐ is “35” and the crankpin mark ⓑ is “81,” then select the bearing colors in “ⓖ.”
- If the connecting rod inside diameter cannot be measured, measure the crankpin oil clearance using Plastigauge (PG-1) and select the suitable combination of upper and lower bearings from the table above so that the oil clearance is within specification.

Checking the crankshaft main journal oil clearance

1. Clean the bearings, main journals, and bearing portions of the crankcase and cylinder block.

2. Place the cylinder block upside down on a bench.

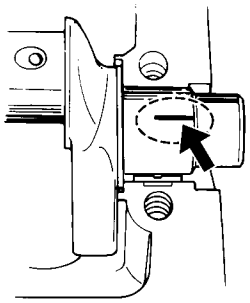
3. Install half of the bearings ① and the crankshaft ② into the cylinder block ③.



S63P5810

NOTE:
Install the main bearings in their original positions.

4. Put a piece of Plastigauge (PG-1) on each main journal parallel to the crankshaft.



S63P5820

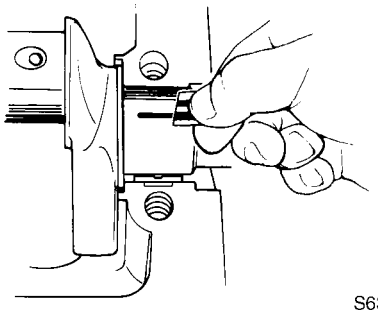
NOTE:
Do not put the Plastigauge (PG-1) over the oil hole in the main journals of the crankshaft.

5. Install the remaining half of the bearings into the main bearing cap and crankcase.

NOTE:
Install the main bearings in their original positions.

6. Install the main bearing cap and crankcase onto the cylinder block and apply engine oil to the threads of the bolts.

7. Remove the main bearing cap and crankcase, and then measure the width of the compressed Plastigauge (PG-1) on each main journal. Replace the main bearing if out of specification.



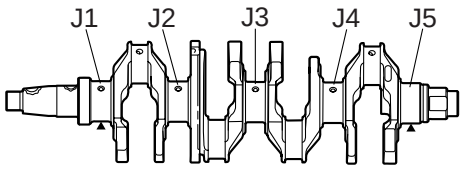
S63P5830

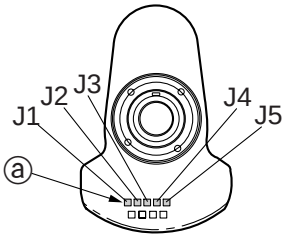
Crankshaft main journal oil clearance:
0.021–0.050 mm
(0.0008–0.0020 in)

Selecting the crankshaft main bearing

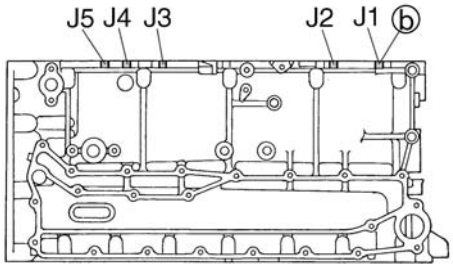
1. When replacing the main bearing, select the suitable bearing as follows.

2. Check the crankshaft journal mark ⓐ on the crankshaft and the cylinder block mark ⓑ on the cylinder block.





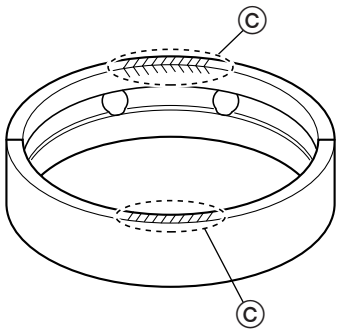
S63P5540



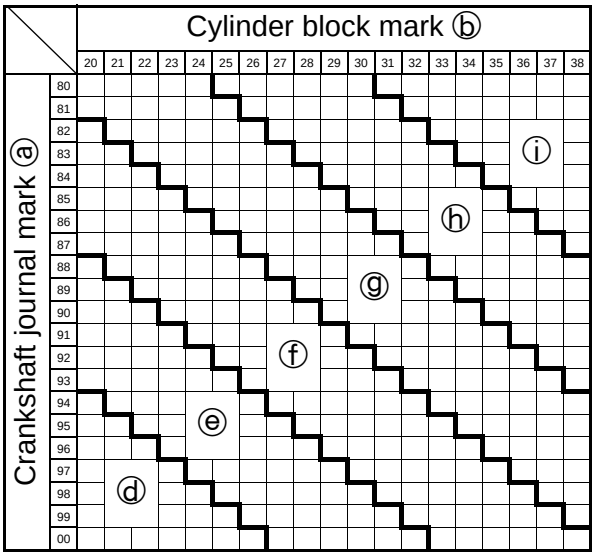
S63P5840

5

3. Select the suitable color ⓒ for the main bearing from the table.



S63P5850

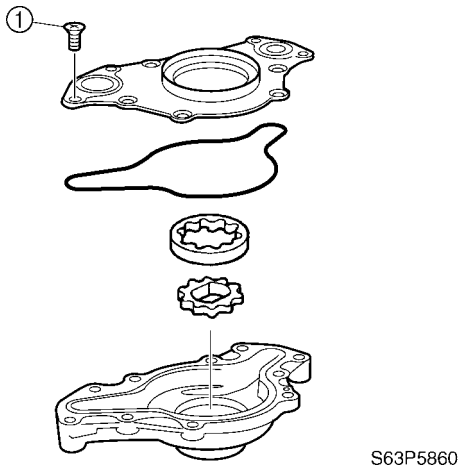


	Upper bearing color	Lower bearing color
ⓓ	Green	Green
ⓔ	Green	Red
ⓕ	Red	Red
ⓖ	Red	Yellow
ⓗ	Yellow	Yellow
ⓘ	Yellow	Blue + green

NOTE:
- Example: If the crankshaft journal mark ⓐ is "89" and the cylinder block mark ⓑ is "28," then select the bearing colors in "ⓖ."
- Main bearing #3 is a thrust bearing.

Disassembling the oil pump

1. Remove the screws ① and disassemble the oil pump.



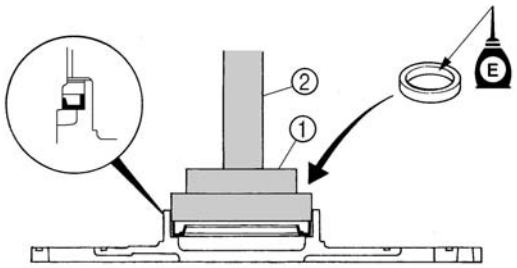
S63P5860

Checking the oil pump

1. Check the gear teeth for cracks or wear and the oil pump case for scratches. Replace the oil pump assembly if necessary.

Assembling the oil pump

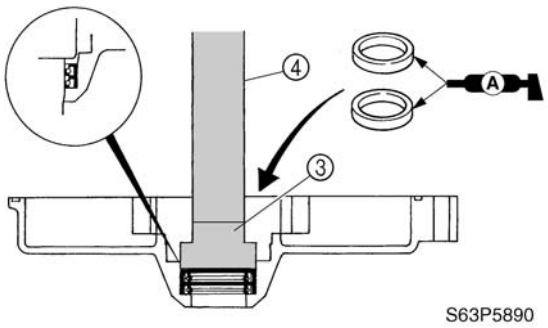
1. Install a new oil seal into the oil pump housing.



S63P5870

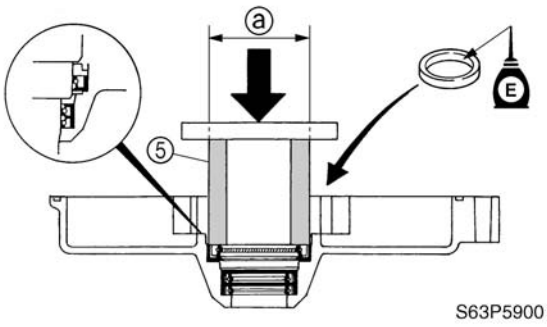
Needle bearing attachment ①: 90890-06654
Driver rod L3 ②: 90890-06652

2. Apply grease to new oil seals, and then install them into the oil pump housing.



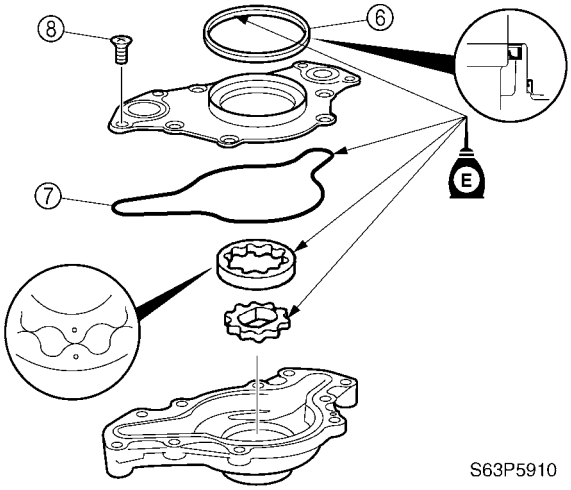
Needle bearing attachment ③:
90890-06611
Driver rod L3 ④: 90890-06652

3. Install a new oil seal into the oil pump housing.



General pipe ⑤:
ⓐ = 45 mm (1.77 in)

4. Install a new oil seal ⑥ and the gasket ⑦, and then tighten the screws ⑧ to the specified torque.

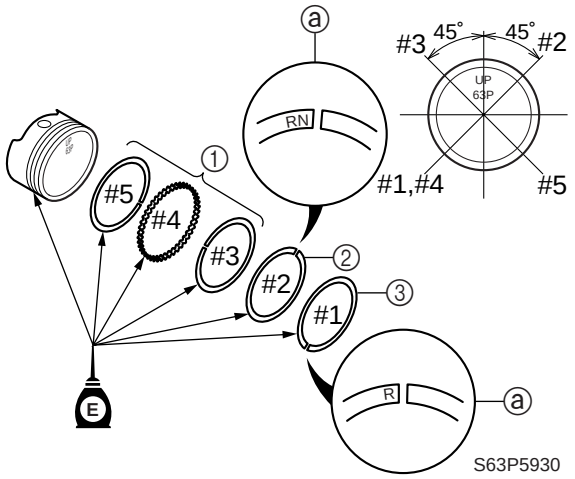


Screw ⑧:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

Assembling the pistons and cylinder block

1. Install the oil ring ①, second ring ②, and top ring ③ onto the pistons with the “RN” mark ⓐ of the second ring and the “R” mark ⓐ of the top ring facing upward.

2. Offset the piston ring end gaps as shown.

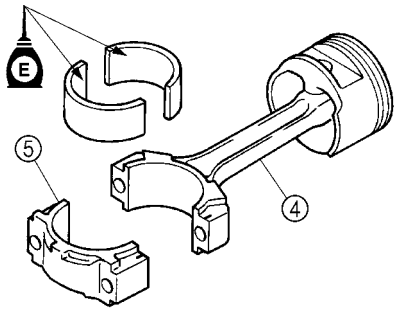


CAUTION:
Do not scratch the pistons or break the piston rings.

NOTE:
After installing the piston rings, check that they move smoothly.

5

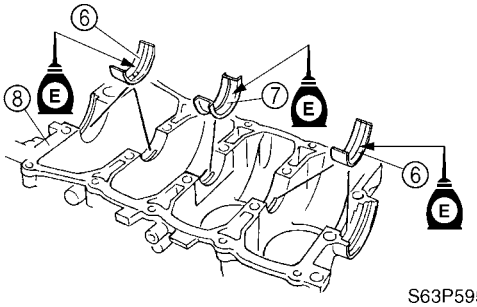
3. Install the upper bearing into the connecting rod ④ and the lower bearing into the connecting rod cap ⑤.



S63P5940

NOTE:
Install the connecting rod bearings in their original positions.

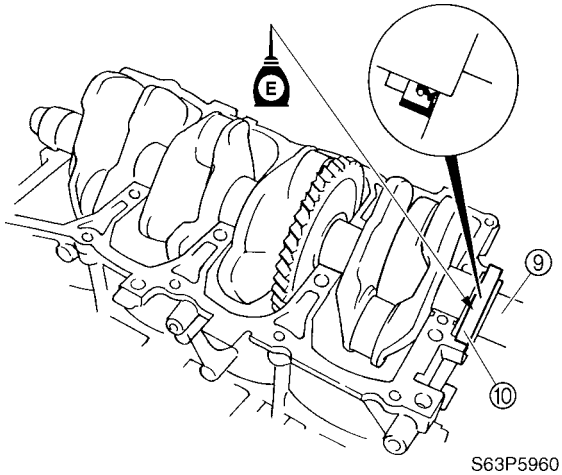
4. Install half of the main bearings ⑥ and the thrust bearing ⑦ into the cylinder block ⑧.



S63P5950

NOTE:
Install the main bearings in their original positions.

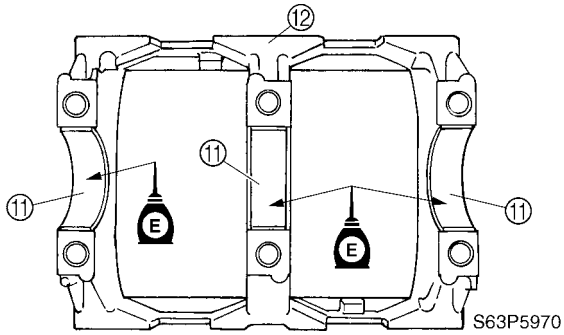
5. Set the crankshaft ⑨ and oil seal ⑩ into the cylinder block as shown.



S63P5960

NOTE:
Apply engine oil to the inner oil seal before installation.

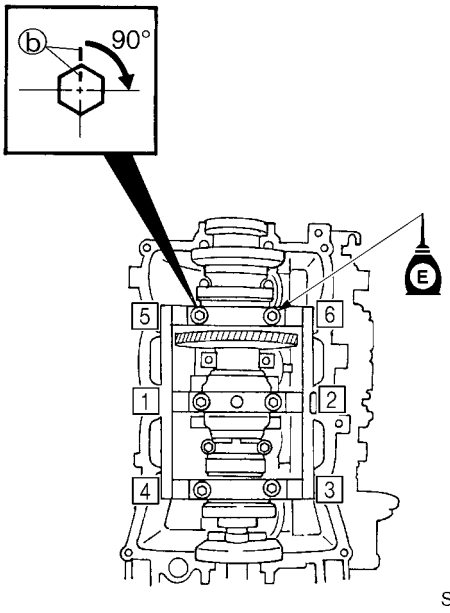
6. Install half of the main bearings ⑪ into the main bearing cap ⑫.



S63P5970

NOTE:
Install the main bearings in their original positions.

7. Tighten the main bearing cap bolts to the specified torques in two stages and in the sequence shown.

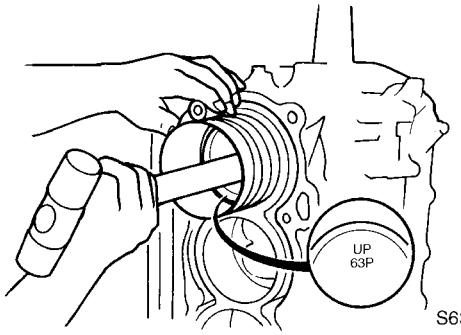


S63P5980

NOTE:
- Main bearing cap bolts 1–6 can be reused three times.
- Apply engine oil to the main bearing cap bolts before installation.
- Make a mark ⓑ on the main bearing caps and main bearing cap bolts, and then tighten the main bearing cap bolts 90° from the mark.

Main bearing cap bolt:
1st: 30 N·m (3.0 kgf·m, 22.1 ft·lb)
2nd: 90°

8. Install the piston with the “UP” mark on the piston crown facing towards the flywheel magnet.

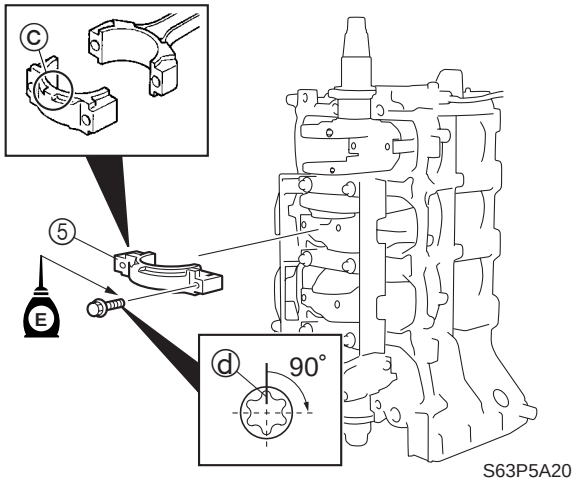


S63P5A10

NOTE:
Apply engine oil to the side of the pistons and piston rings before installation.

Piston ring compressor:
90890-05158

9. Install the connecting rod caps ⑤ to the connecting rods, and then tighten the connecting rod bolts to the specified torques in three stages.



S63P5A20

CAUTION:
Do not reuse the connecting rod bolts, always replace them with new ones.

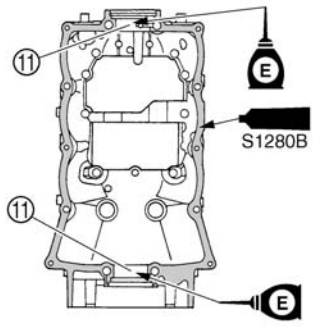
NOTE:
- Make sure that the mark ⓒ of the connecting rod faces towards the flywheel magnet side of the crankshaft.
- Apply engine oil to the connecting rod bolts before installation.
- Make a mark ⓓ on the connecting rod bolts and connecting rod caps, and then tighten the bolts 90° from the mark.

Connecting rod bolt:
1st: 23 N·m (2.3 kgf·m, 17.0 ft·lb)
2nd: 43 N·m (4.3 kgf·m, 31.7 ft·lb)
3rd: 90°

5

10. Install half of the main bearings ⑪ into the crankcase.

11. Apply sealant to the mating surface of the crankcase.

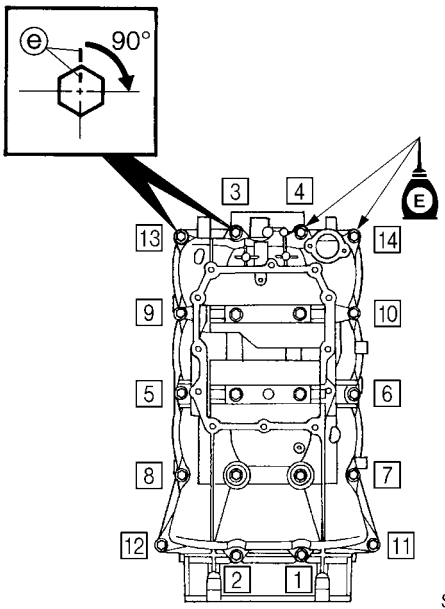


S63P5A30

NOTE:
- Install the main bearings in their original positions.
- Do not get any sealant on the main bearings.

12. Install the crankcase onto the cylinder block.

13. Tighten the crankcase bolts to the specified torques in two stages and in the sequence shown.

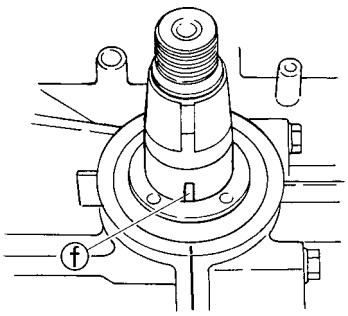


S63P5990

NOTE:
- Crankcase bolts 1–4 can be reused three times.
- Apply engine oil to the crankcase bolts before installation.
- Tighten crankcase bolts 1–4 to the specified torques in two stages first, and then tighten crankcase bolts 5–14 to the specified torques in two stages.
- Make a mark ⓔ on the crankcase and crankcase bolts, and then tighten crankcase bolts 1–4 90° from the mark.

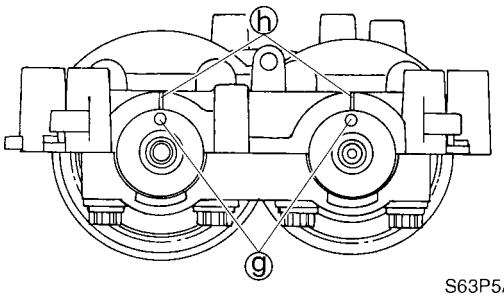
1–4 Crankcase bolt (M10):
1st: 30 N·m (3.0 kgf·m, 22.1 ft·lb)
2nd: 90°
5–14 Crankcase bolt (M8):
1st: 14 N·m (1.4 kgf·m, 10.3 ft·lb)
2nd: 26 N·m (2.6 kgf·m, 19.2 ft·lb)

14. Align the keyway ⓕ in the crankshaft with the cylinder block and crankcase mating surfaces.



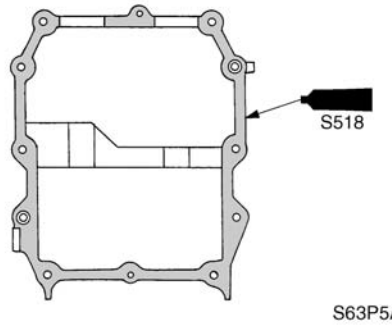
S63P5A40

15. Align the marks ⓖ on the balancer shafts with the alignment marks ⓗ.



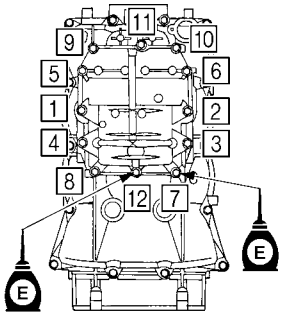
S63P5A50

16. Apply sealant to the mating surface of the balancer assembly.



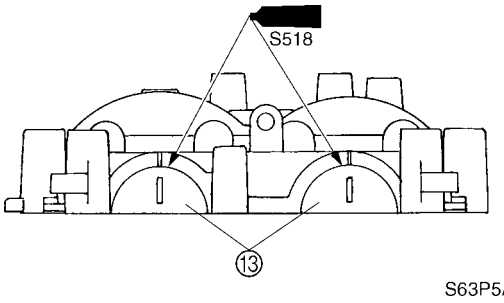
NOTE:
Do not get any sealant inside the balancer assembly.

17. Install the balancer assembly onto the crankcase, and then tighten the balancer assembly bolts to the specified torques in two stages and in the sequence shown.

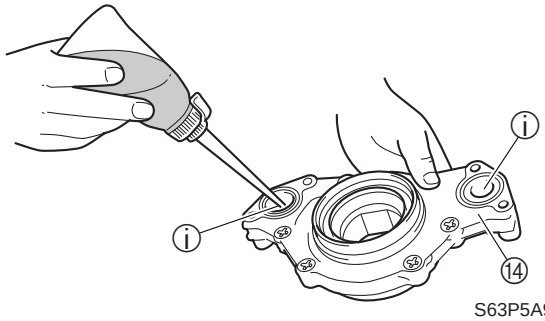


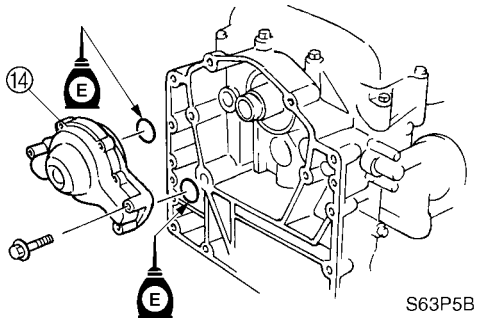
	1–10 Balancer bolt (M8): 1st: 18 N·m (1.8 kgf·m, 13.3 ft·lb) 2nd: 31 N·m (3.1 kgf·m, 22.9 ft·lb) 11, 12 Balancer bolt (M6): 1st: 7 N·m (0.7 kgf·m, 5.2 ft·lb) 2nd: 13 N·m (1.3 kgf·m, 9.6 ft·lb)

18. After installing the balancer assembly onto the crankcase, apply sealant around the periphery of the seals ⑬, and then install them onto the balancer assembly.



19. Align the oil pump gear with the crankshaft, and then install the oil pump ⑭.

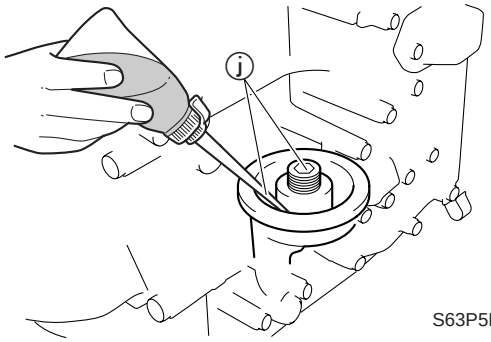




NOTE:
- Before installing the oil pump, be sure to fill it with a small amount of engine oil through the oil passage ⓘ.
- When installing the oil pump, install it so that the oil seal does not get damaged.

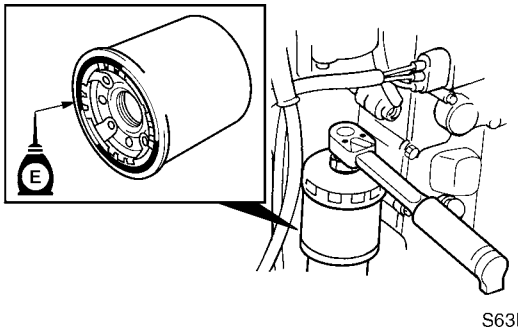
5

20. Before installing the oil filter, be sure to fill it with engine oil through the oil passage ⓙ of the oil filter bracket.



S63P5B20

21. Install the oil filter, and then tighten it to the specified torque using a 72.5 mm (2.9 in) oil filter wrench.



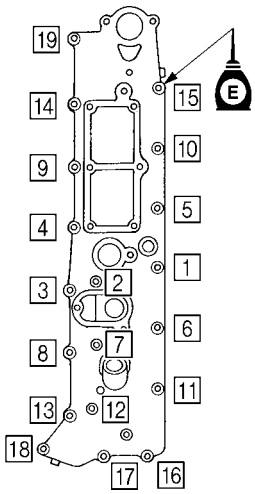
S63P5B30

NOTE:
Apply a thin coat of engine oil to the O-ring of the new oil filter before installation.

Oil filter wrench: 90890-06830

Oil filter:
18 N·m (1.8 kgf·m, 13.3 ft·lb)

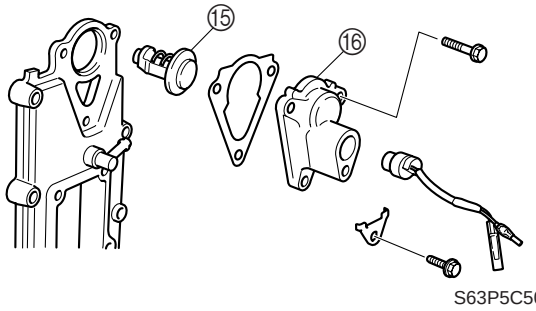
22. Install a new gasket and the exhaust cover, and then tighten the bolts to the specified torques in two stages and in the sequence shown.



S63P5C40

Exhaust cover bolt:
1st: 6 N·m (0.6 kgf·m, 4.4 ft·lb)
2nd: 12 N·m (1.2 kgf·m, 8.9 ft·lb)

23. Install the thermostat ⑮ and cover ⑯.



S63P5C50

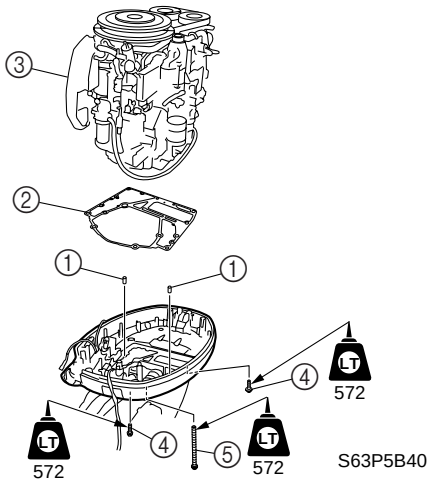
Thermostat cover bolt:
1st: 6 N·m (0.6 kgf·m, 4.4 ft·lb)
2nd: 12 N·m (1.2 kgf·m, 8.9 ft·lb)

Installing the power unit

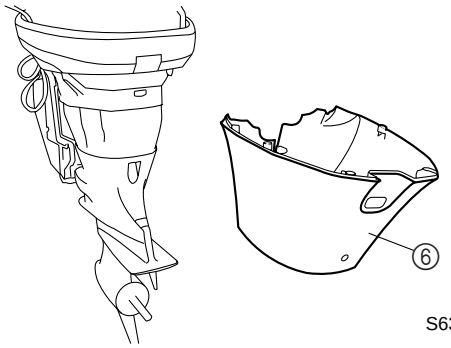
1. Clean the power unit mating surface, and install the dowels ① and a new gasket ②.

2. Install the power unit ③ by installing the bolts ④ and bolts ⑤, then tightening them to the specified torque.

3. Install the apron ⑥, then tighten them to the specified torque.



S63P5B40

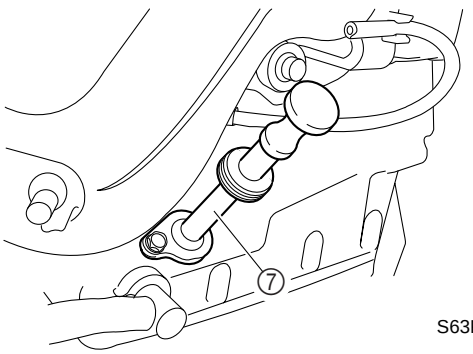


S63P5B50

	Power unit mounting bolt (M8) ④: 20 N·m (2.0 kgf·m, 14.8 ft·lb) Power unit mounting bolt (M10) ⑤: 42 N·m (4.2 kgf·m, 31.0 ft·lb) Apron bolt: 8 N·m (0.8 kgf·m, 5.9 ft·lb) Apron screw: 4 N·m (0.4 kgf·m, 3.0 ft·lb)

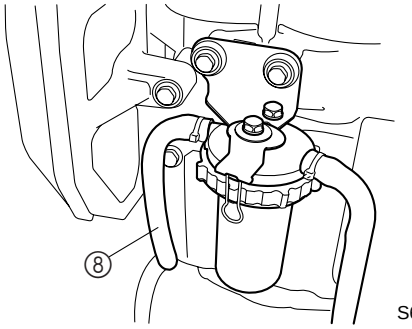
4. Connect the PTT switch coupler, shift cut switch coupler, neutral switch coupler, cooling water pilot hose, and flushing hose.

5. Install the dipstick guide ⑦.



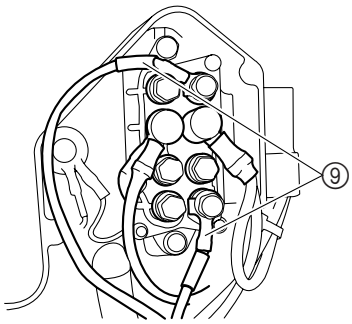
S63P5C80

6. Connect the fuel hose ⑧.



S63P5B80

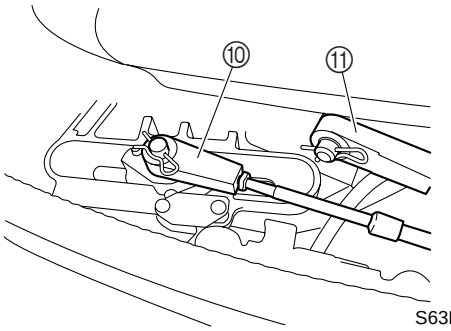
7. Connect the PTT motor leads ⑨, and then install the junction box cover.



S63P5B90

	PTT motor lead bolt: 4 N·m (0.4 kgf·m, 3.0 ft·lb)

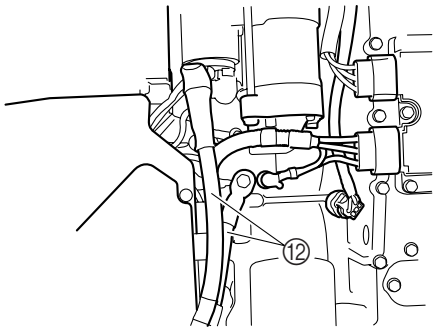
8. Connect the shift cable ⑩ and throttle cable ⑪, and then adjust their lengths. For adjustment procedures, see Chapter 3, “Adjusting the throttle link and throttle cable” and “Checking the gear shift operation.”



S63P5B60

5

9. Connect the battery leads ⑫.

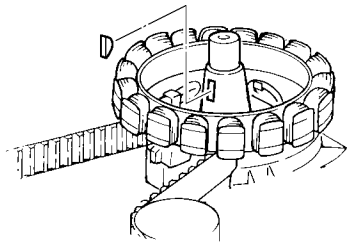


S63P5C10

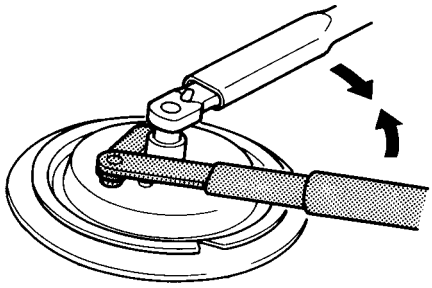
Positive battery cable nut:
9 N·m (0.9 kgf·m, 6.6 ft·lb)

10. Install the stator coil assembly.

11. Install the Woodruff key.


S63P5350

12. Install the flywheel magnet.


S63P5370

CAUTION:
Apply force in the direction of the arrows shown to prevent the flywheel holder from slipping off easily.

NOTE:
Apply engine oil to the flywheel magnet nut before installation.

Flywheel holder: 90890-06522

Flywheel magnet nut:
270 N·m (27.0 kgf·m, 199.1 ft·lb)

13. Install all parts removed during disassembly.

— MEMO —

Lower unit

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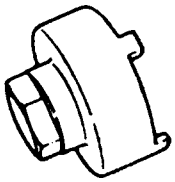
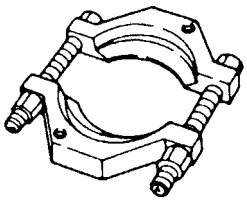
Backlash (counter rotation model) 6-60
Measuring the forward and reverse gear backlash 6-60

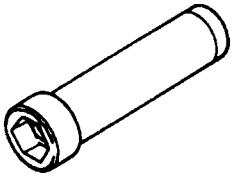
Special service tools



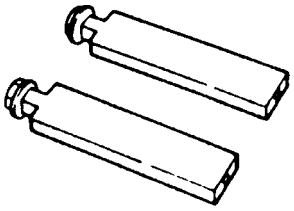
Ring nut wrench 4
90890-06512



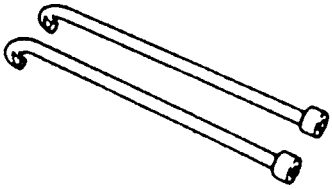
Bearing separator
90890-06534



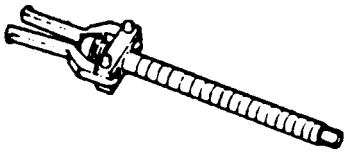
Ring nut wrench extension
90890-06513



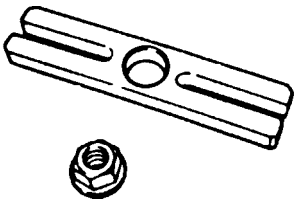
Stopper guide stand
90890-06538



Bearing housing puller claw L
90890-06502

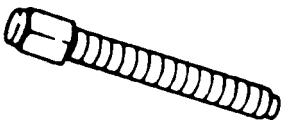


Bearing puller assembly
90890-06535

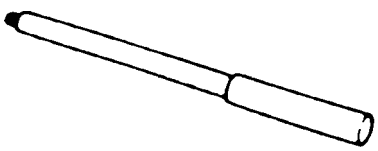


Stopper guide plate
90890-06501

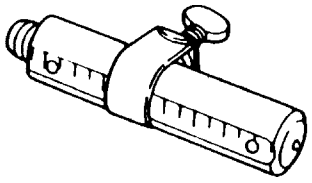
Needle bearing attachment
90890-06610, 90890-06612, 90890-06653, 90890-06654



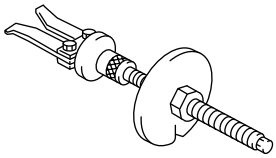
Center bolt
90890-06504



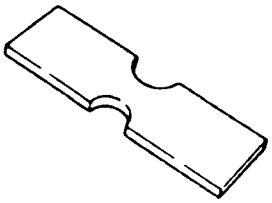
Driver rod L3
90890-06652



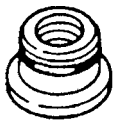
Driver rod SS
90890-06604



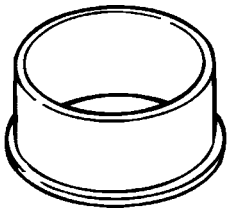
Bearing outer race puller assembly
90890-06523



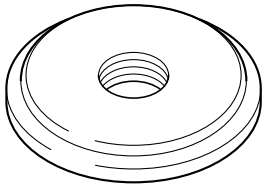
Bearing depth plate
90890-06603



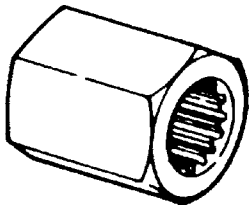
Ball bearing attachment
90890-06633, 90890-06636, 90890-06629



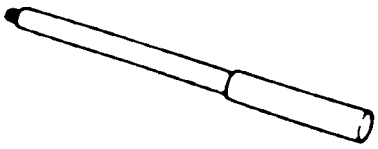
Bearing inner race attachment
90890-06640, 90890-06660



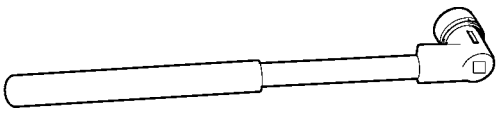
Bearing outer race attachment
90890-06619



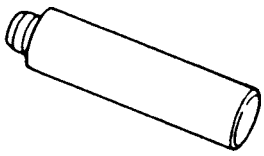
Drive shaft holder 6
90890-06520



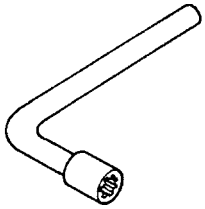
Driver rod LL
90890-06605



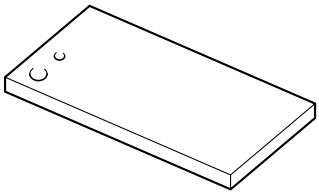
Pinion nut holder
New: 90890-06715
Current: 90890-06505



Driver rod LS
90890-06606

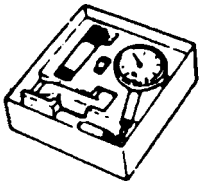


Shift rod push arm
90890-06052

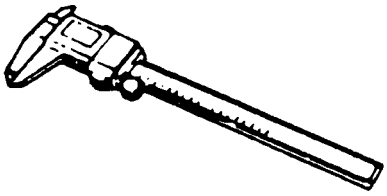


Magnet base plate
90890-07003

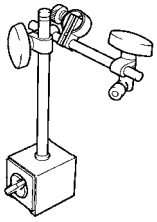
Pinion height gauge
90890-06710



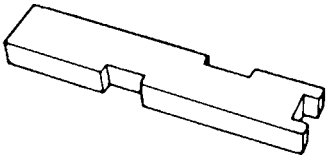
Dial gauge set
90890-01252



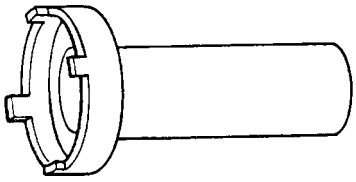
Digital caliper
90890-06704



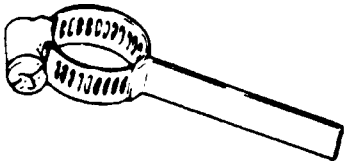
Magnet base B
90890-06844



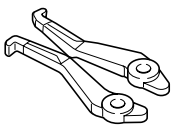
Shimming plate
90890-06701



Ring nut wrench
90890-06578

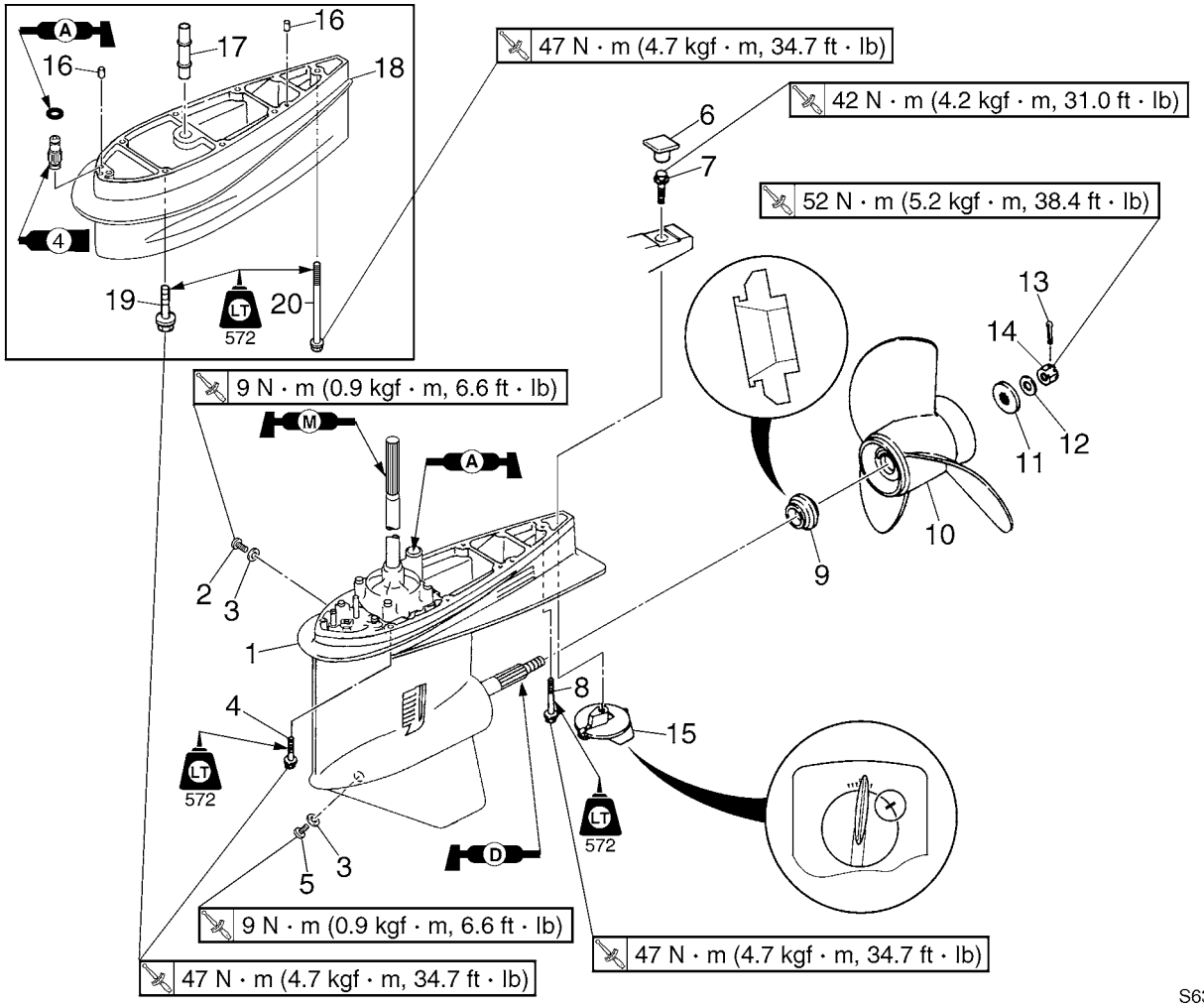


Backlash indicator
90890-06706

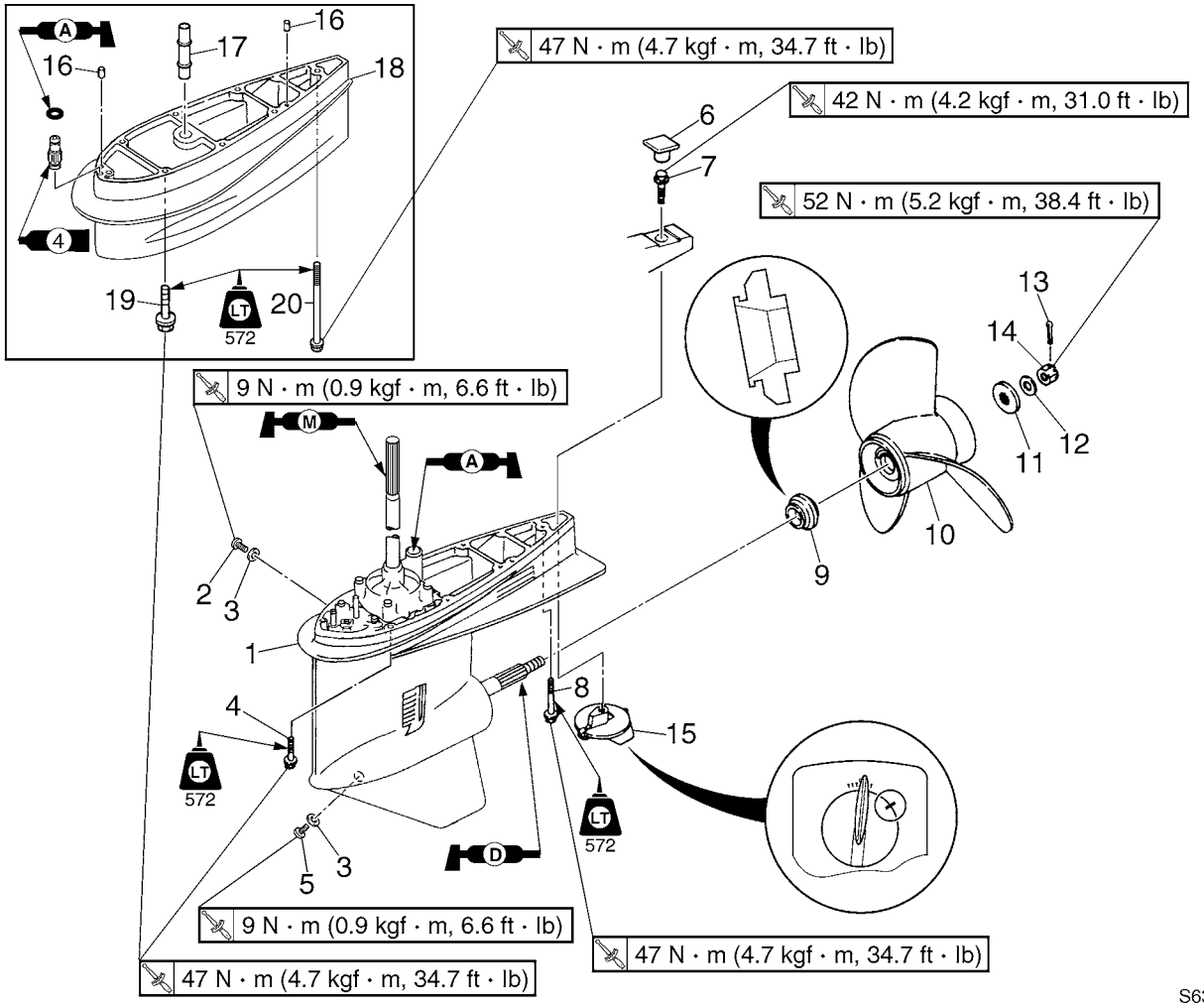


Outer race puller claw B
90890-06533

Lower unit (regular rotation model)


47 N · m (4.7 kgf · m, 34.7 ft · lb)
42 N · m (4.2 kgf · m, 31.0 ft · lb)
52 N · m (5.2 kgf · m, 38.4 ft · lb)
9 N · m (0.9 kgf · m, 6.6 ft · lb)
9 N · m (0.9 kgf · m, 6.6 ft · lb)
47 N · m (4.7 kgf · m, 34.7 ft · lb)
47 N · m (4.7 kgf · m, 34.7 ft · lb)
572
572
572
S63P6010

No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Check screw	1	
3	Gasket	2	**Not reusable**
4	Bolt	6	M10 × 45 mm
5	Drain screw	1	
6	Grommet	1	
7	Bolt	1	M10 × 44 mm
8	Bolt	1	M10 × 70 mm / L-transom model
9	Spacer	1	
10	Propeller	1	
11	Washer	1	
12	Washer	1	
13	Cotter pin	1	**Not reusable**
14	Propeller nut	1	
15	Trim tab	1	
16	Dowel	2	X-transom model
17	Water pipe	1	X-transom model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52 N · m (5.2 kgf · m, 38.4 ft · lb)
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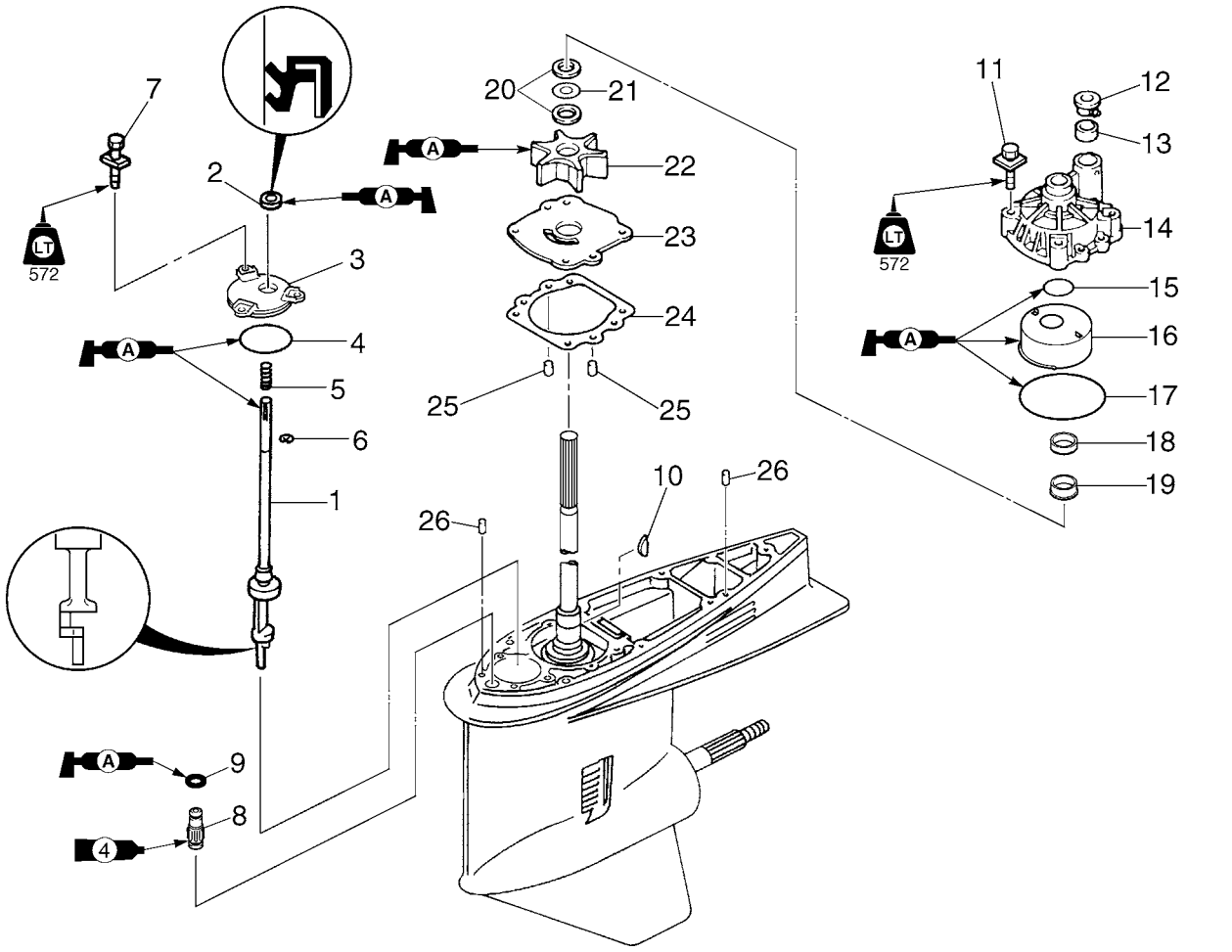
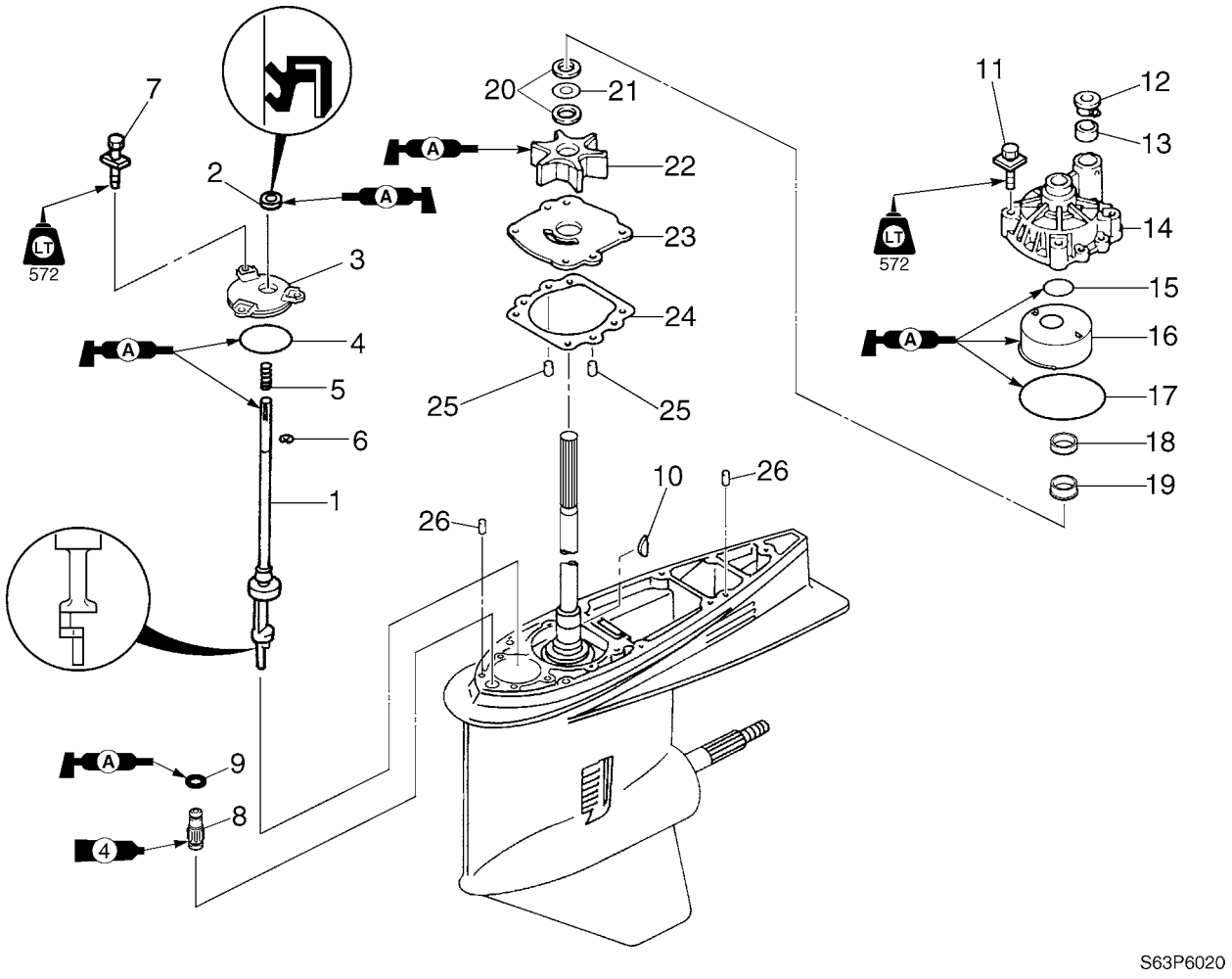
47 N · m (4.7 kgf · m, 34.7 ft · lb)
47 N · m (4.7 kgf · m, 34.7 ft · lb)
572
572
572
S63P6010

No.	Part name	Q'ty	Remarks
18	Extension	1	X-transom model
19	Bolt	6	M10 × 45 mm / X-transom model
20	Bolt	1	M10 × 200 mm / X-transom model



No.	Part name	Q'ty	Remarks
1	Shift rod	1	
2	Oil seal	1	**Not reusable**
3	Oil seal housing	1	
4	O-ring	1	**Not reusable**
5	Spring	1	
6	Circlip	1	
7	Bolt	3	M6 × 20 mm
8	Hose nipple	1	
9	O-ring	1	**Not reusable**
10	Woodruff key	1	
11	Bolt	4	M8 × 45 mm
12	Cover	1	
13	Seal	1	
14	Water pump housing	1	
15	O-ring	1	**Not reusable**
16	Insert cartridge	1	
17	O-ring	1	**Not reusable**



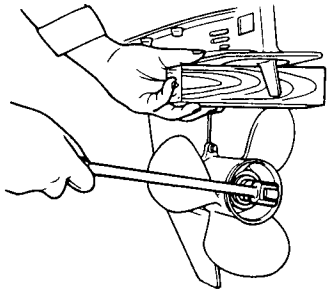
S63P6020

No.	Part name	Q'ty	Remarks
18	Collar	1	
19	Spacer	1	
20	Washer	2	
21	Wave washer	1	
22	Impeller	1	
23	Outer plate cartridge	1	
24	Gasket	1	**Not reusable**
25	Dowel	2	
26	Dowel	2	

Removing the lower unit

1. Drain the gear oil. For draining procedures, see Chapter 3, “Changing the gear oil.”

2. Set the gear shift to the neutral position, and place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then remove the propeller nut and propeller.



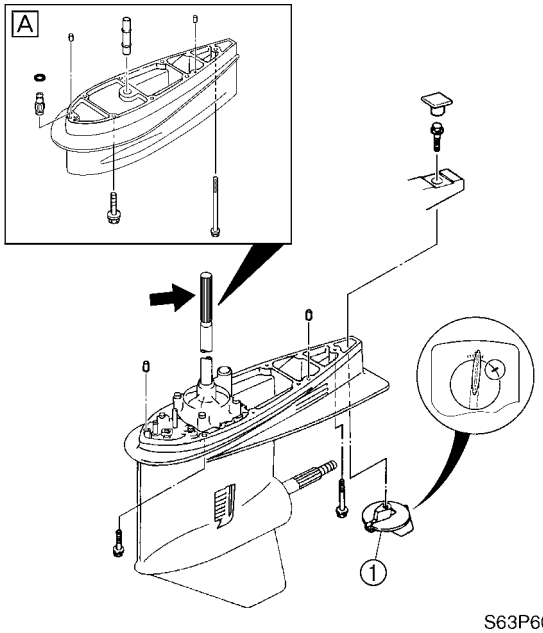
S69J6015

⚠ WARNING

- **Do not hold the propeller with your hands when loosening or tightening it.**
- **Be sure to disconnect the battery leads from the battery and the engine stop lanyard from the engine stop lanyard switch.**
- **Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**

3. Mark the trim tab ① at the area shown, and then remove it.

4. Loosen the bolts, and then remove the lower unit from the upper case.



S63P6030

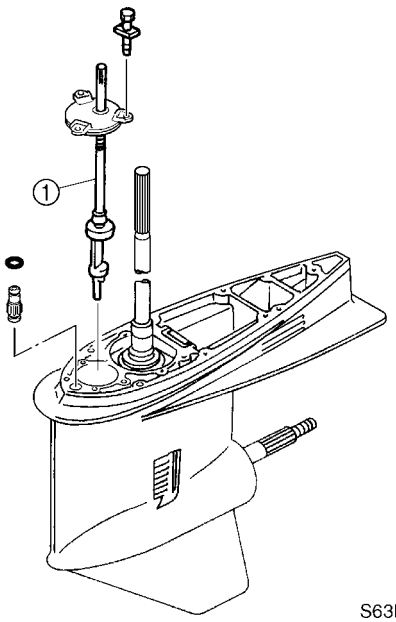
A X-transom model

NOTE:

Check that there is no oil on the spline and check it for wear.

Removing the water pump and shift rod

1. Remove the water pump assembly and shift rod assembly ①.

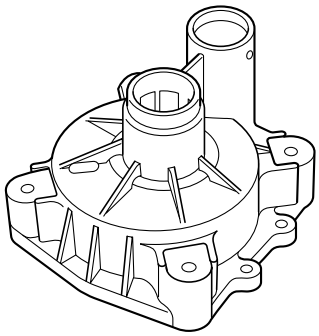


S63P6040

6

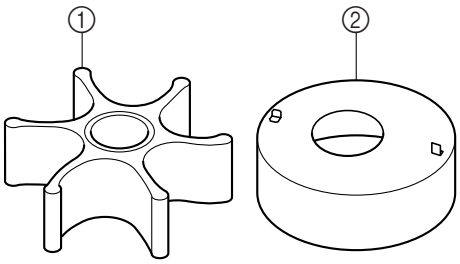
Checking the water pump and shift rod

1. Check the water pump housing for deformation. Replace if necessary.



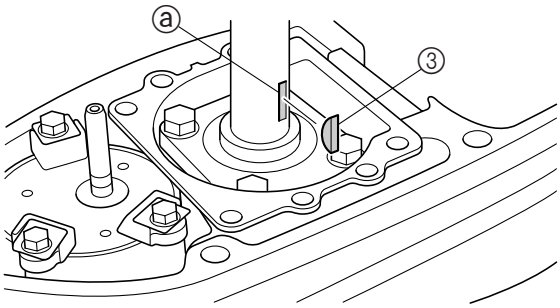
S69J6030

2. Check the impeller ① and insert cartridge ② for cracks or wear. Replace if necessary.



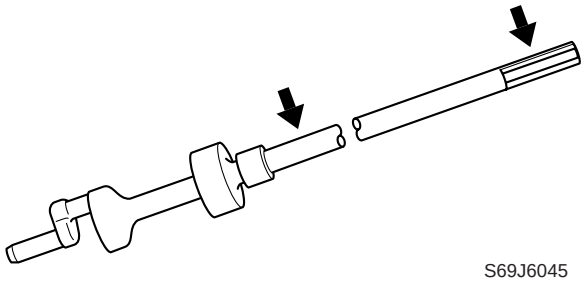
S63P6050

3. Check the Woodruff key ③ and the keyway ⓐ in the drive shaft for wear. Replace if necessary.



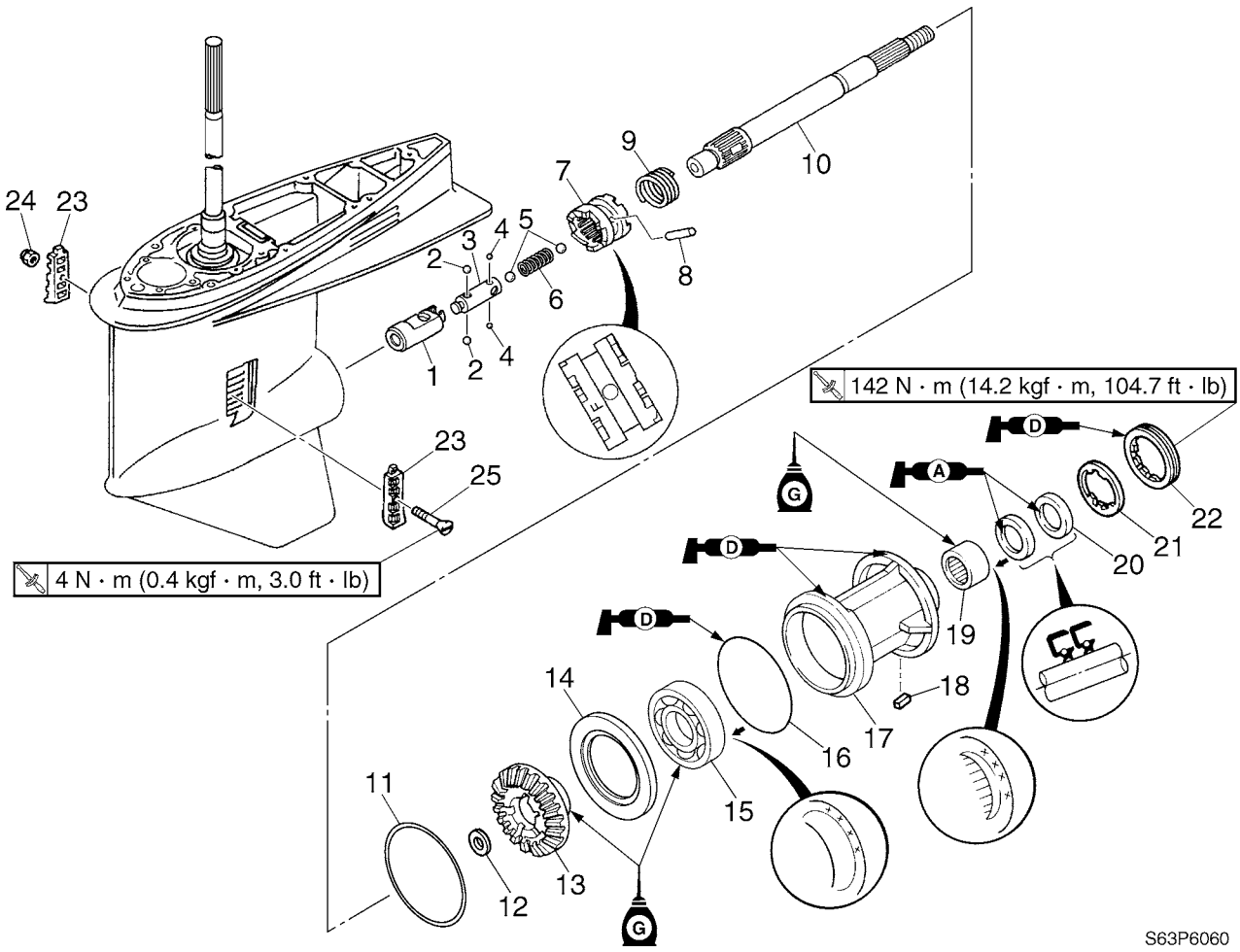
S69J6040

4. Check the shift rod for cracks or wear. Replace if necessary.

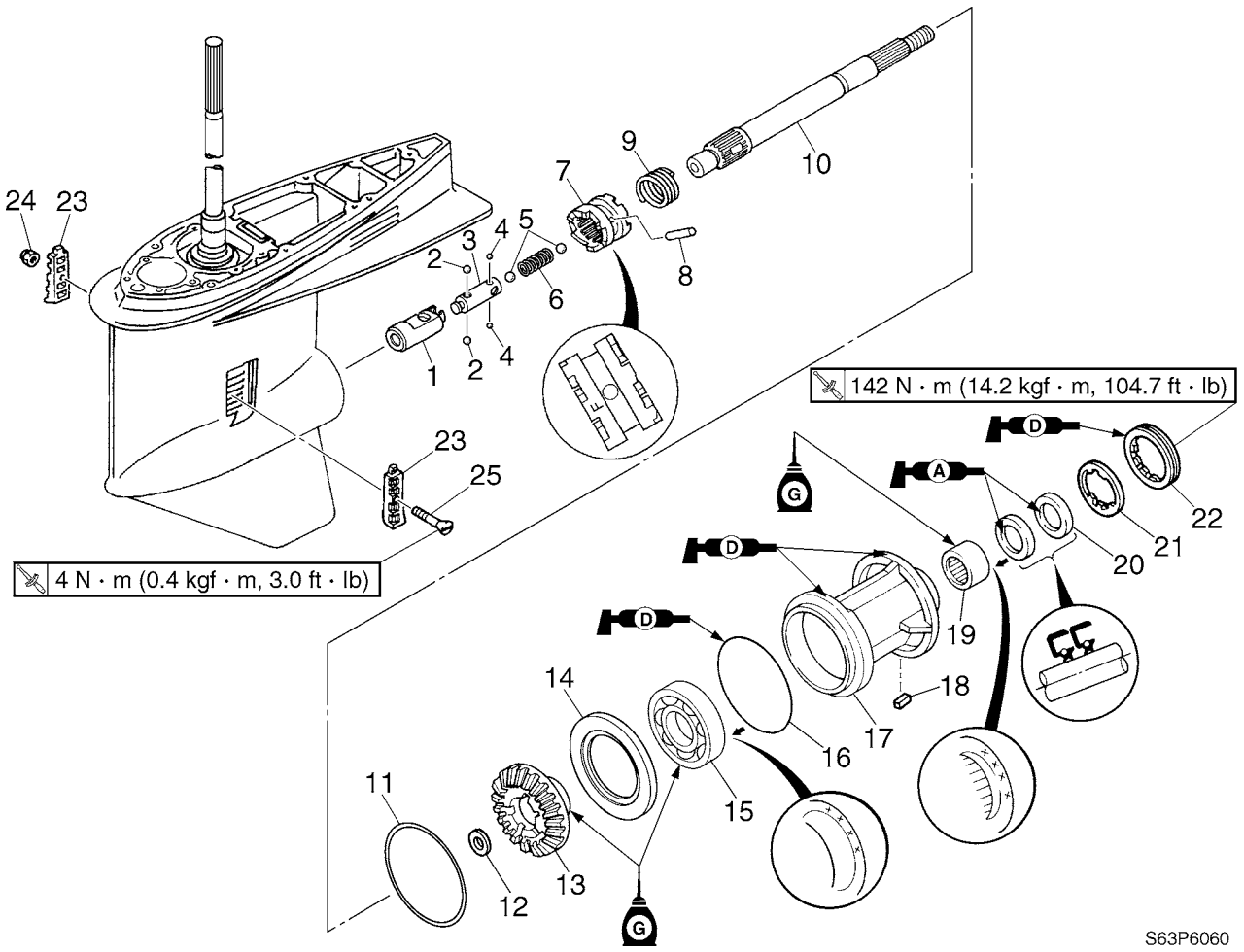


S69J6045

Propeller shaft housing (regular rotation model)



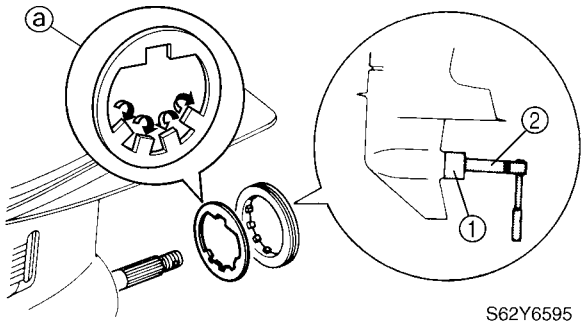
No.	Part name	Q'ty	Remarks
1	Shift rod joint	1	
2	Ball	2	
3	Shift slider	1	
4	Ball	2	
5	Ball	2	
6	Spring	1	
7	Dog clutch	1	
8	Cross pin	1	
9	Spring	1	
10	Propeller shaft	1	
11	Reverse gear shim	—	
12	Washer	1	
13	Reverse gear	1	
14	Thrust washer	1	
15	Ball bearing	1	**Not reusable**
16	O-ring	1	**Not reusable**
17	Propeller shaft housing	1	



No.	Part name	Q'ty	Remarks
18	Straight key	1	
19	Needle bearing	1	
20	Oil seal	2	**Not reusable**
21	Claw washer	1	
22	Ring nut	1	
23	Cooling water inlet cover	2	
24	Nut	1	
25	Screw	1	

Removing the propeller shaft housing assembly

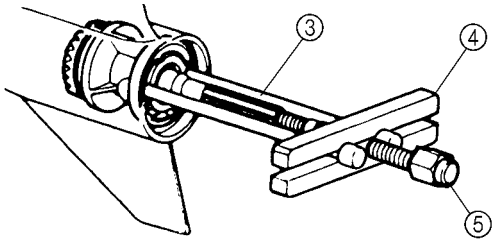
1. Straighten the claw washer tabs ⓐ, and then remove the ring nut and claw washer.



S62Y6595

Ring nut wrench 4 ①: 90890-06512
Ring nut wrench extension ②: 90890-06513

2. Pull out the propeller shaft housing assembly.

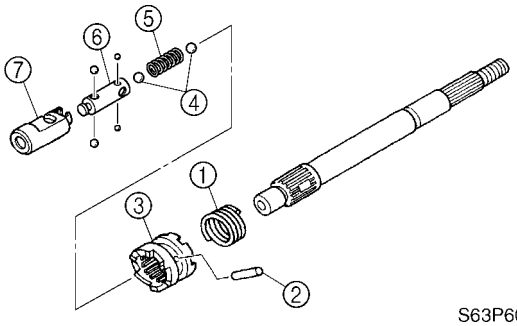


S68S6310

Bearing housing puller claw L ③: 90890-06502
Stopper guide plate ④: 90890-06501
Center bolt ⑤: 90890-06504

Disassembling the propeller shaft assembly

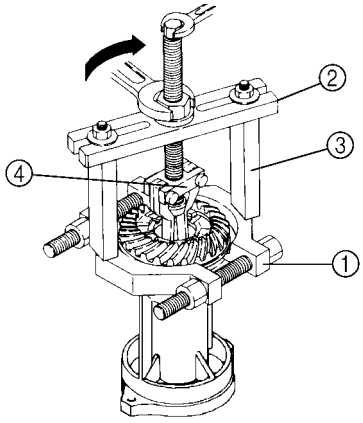
1. Remove the spring ①, then the cross pin ②, dog clutch ③, balls ④, spring ⑤, shift slider ⑥, and shift rod joint ⑦.



S63P6070

Disassembling the propeller shaft housing

1. Remove the reverse gear and thrust washer.

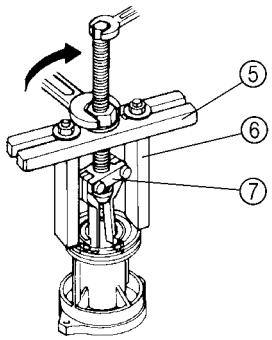


S68S6330

Bearing separator ①: 90890-06534
Stopper guide plate ②: 90890-06501
Stopper guide stand ③: 90890-06538
Bearing puller assembly ④: 90890-06535

6

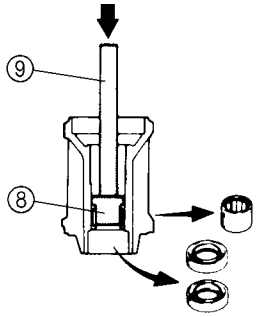
2. Remove the ball bearing.



S68S6340

Stopper guide plate ⑤: 90890-06501
Stopper guide stand ⑥: 90890-06538
Bearing puller assembly ⑦: 90890-06535

3. Remove the oil seals and needle bearing.

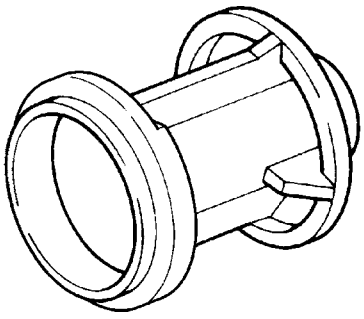


S68S6350

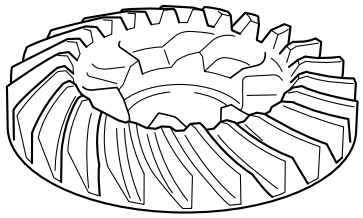
Needle bearing attachment ⑧: 90890-06653
Driver rod L3 ⑨: 90890-06652

Checking the propeller shaft housing

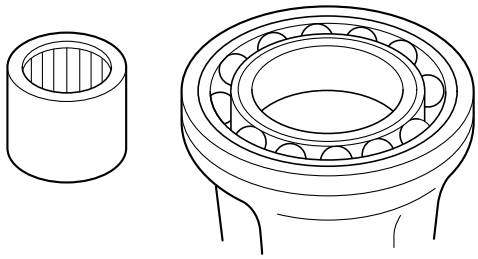
1. Clean the propeller shaft housing using a soft brush and cleaning solvent, and then check it for cracks. Replace if necessary.


S62Y6650

2. Check the teeth and dogs of the reverse gear for cracks or wear. Replace the gear if necessary.

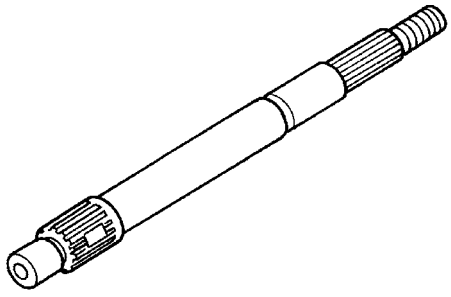

S62Y6640

3. Check the bearings for pitting or rumbling. Replace if necessary.

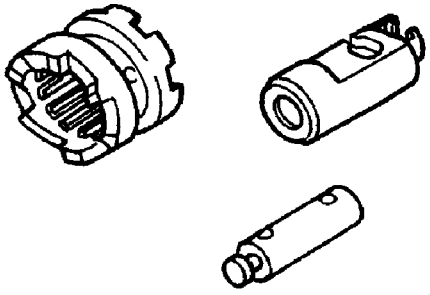

S69J6115

Checking the propeller shaft

1. Check the propeller shaft for bends or wear. Replace if necessary.


S69J6120

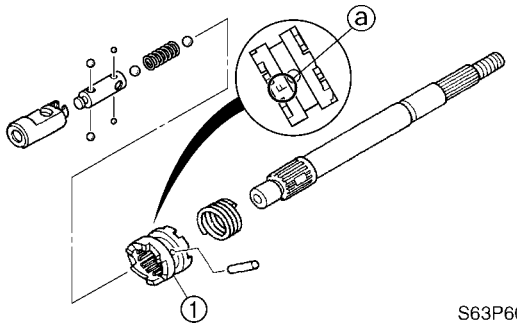
2. Check the dog clutch, shift rod joint and shift slider for cracks or wear. Replace if necessary.



S69J6125

Assembling the propeller shaft assembly

1. Install the dog clutch as shown.

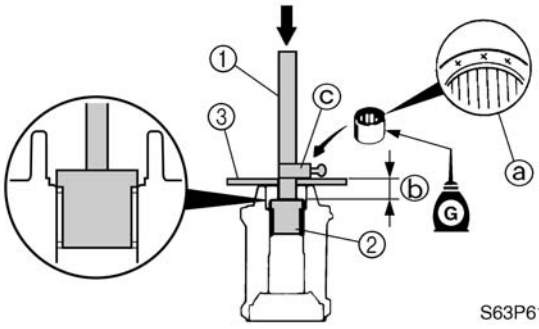


S63P6080

NOTE:
Install the dog clutch ① with the "F" mark ⓐ facing toward the shift slider.

Assembling the propeller shaft housing

1. Install the needle bearing into the propeller shaft housing to the specified depth.



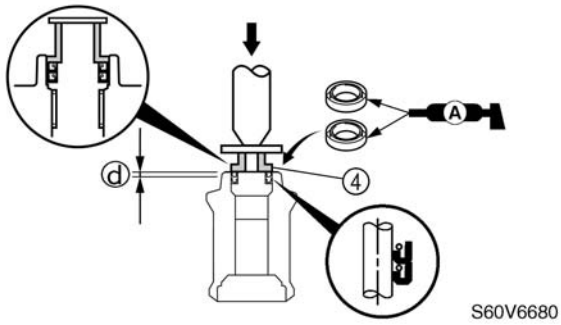
S63P6100

NOTE:
- Install the needle bearing with the manufacture identification mark ⓐ facing toward the oil seal (propeller side).
- When using the driver rod, do not strike the special service tool in a manner that will force the stopper ⓒ out of place.

Driver rod SS ①: 90890-06604
Needle bearing attachment ②: 90890-06610
Bearing depth plate ③: 90890-06603

Depth ⓑ:
24.75–25.25 mm (0.974–0.994 in)

2. Apply grease to new oil seals, and then install them into the propeller shaft housing to the specified depth.



S60V6680

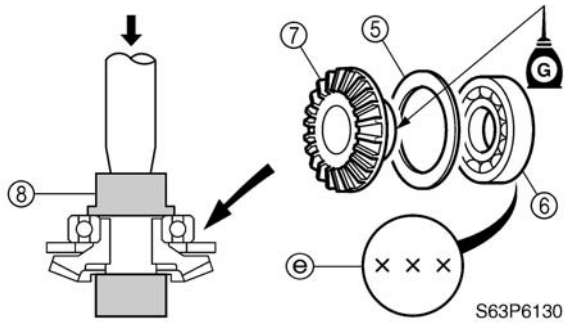
NOTE:
Install an oil seal halfway into the propeller shaft housing, then the other oil seal.

Bearing inner race attachment ④:
90890-06640

Depth ⓓ:
4.75–5.25 mm (0.187–0.207 in)

6

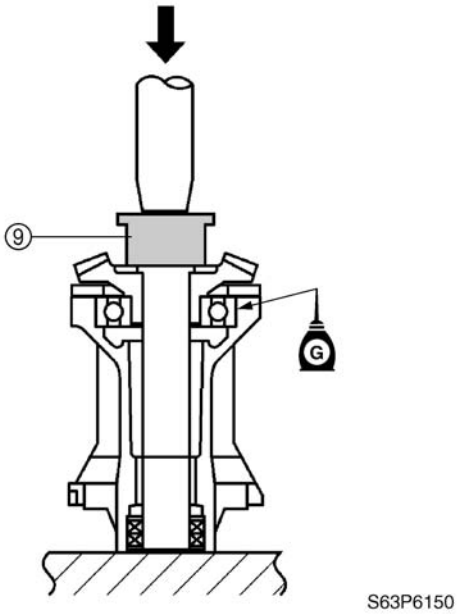
3. Install the thrust washer ⑤ and new ball bearing ⑥ onto the reverse gear ⑦ using a press.



NOTE:
Install the ball bearing with the manufacture identification mark ⓔ facing outward (propeller side).

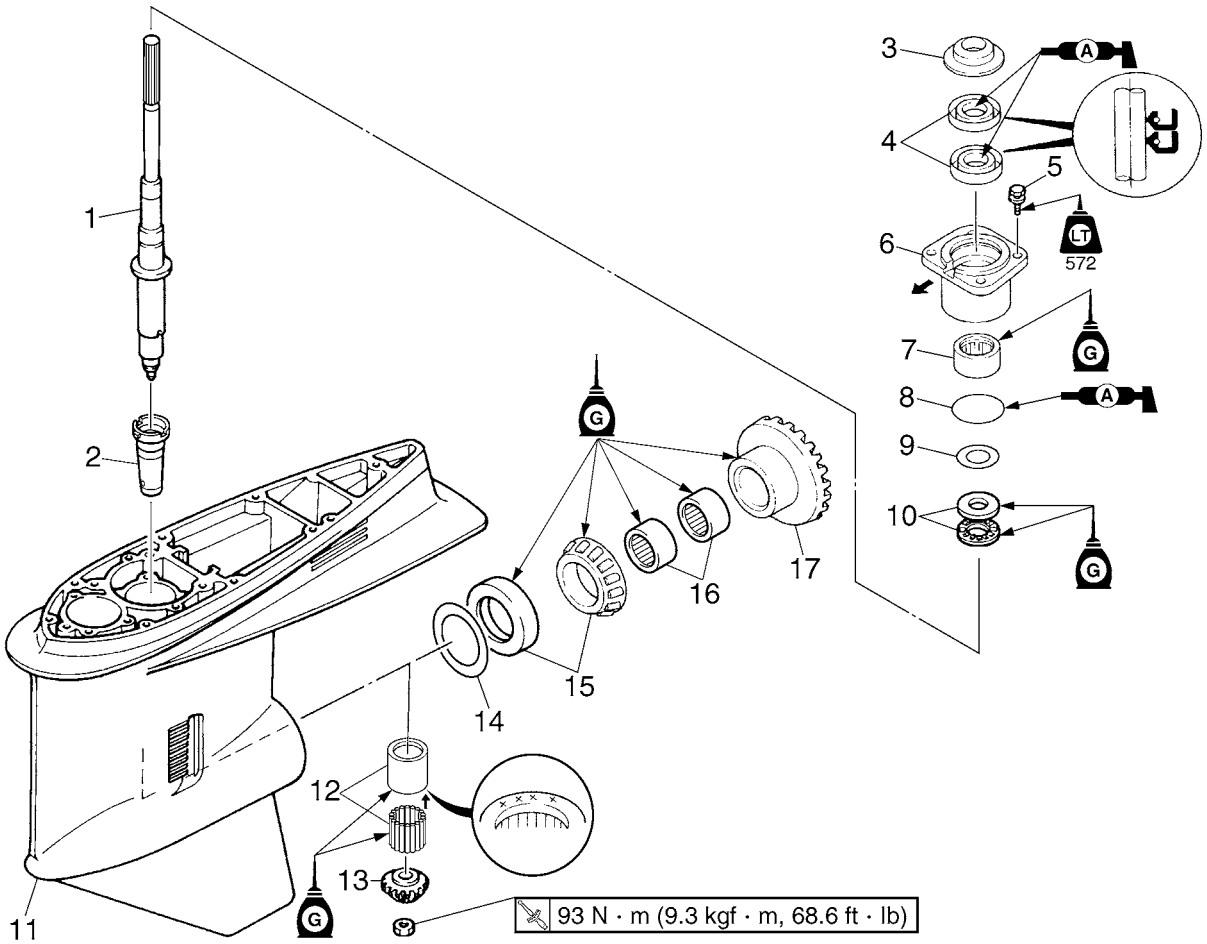
Needle bearing attachment ⑧:
90890-06654

4. Install the reverse gear assembly into the propeller shaft housing using a press.



Needle bearing attachment ⑨:
90890-06654

Drive shaft and lower case (regular rotation model)



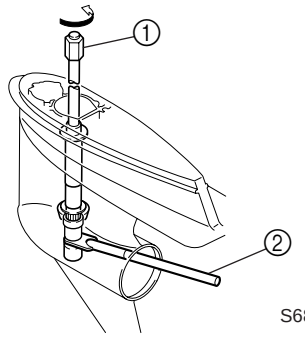
S63P6160

No.	Part name	Q'ty	Remarks
1	Drive shaft	1	
2	Sleeve	1	
3	Cover	1	
4	Oil seal	2	**Not reusable**
5	Bolt	4	M8 × 25 mm
6	Drive shaft housing	1	
7	Needle bearing	1	
8	O-ring	1	**Not reusable**
9	Pinion shim	—	
10	Thrust bearing	1	
11	Lower case	1	
12	Needle bearing assembly	1	
13	Pinion	1	
14	Forward gear shim	—	
15	Taper roller bearing assembly	1	**Not reusable**
16	Needle bearing	2	
17	Forward gear	1	

6

Removing the drive shaft

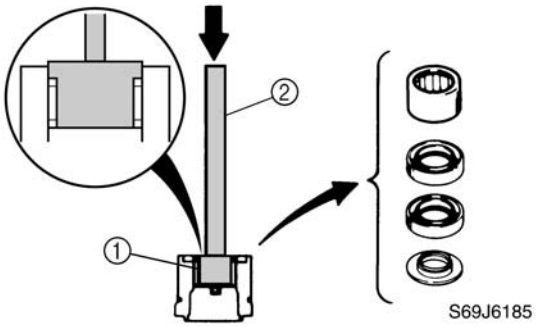
1. Remove the drive shaft, drive shaft housing, and pinion, and then pull out the forward gear.



Drive shaft holder 6 ①: 90890-06520
Pinion nut holder ②:
New: 90890-06715
Current: 90890-06505

Disassembling the drive shaft housing

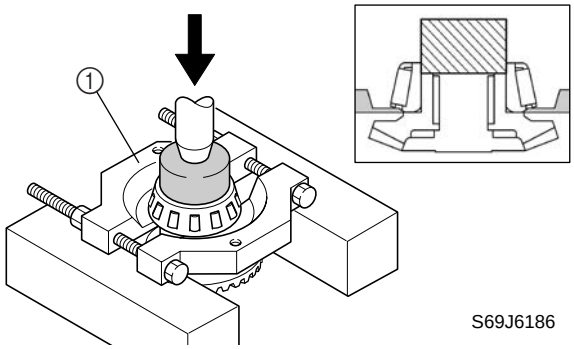
1. Remove the cover, oil seals, and needle bearing.



Needle bearing attachment ①:
90890-06610
Driver rod L3 ②: 90890-06652

Disassembling the forward gear

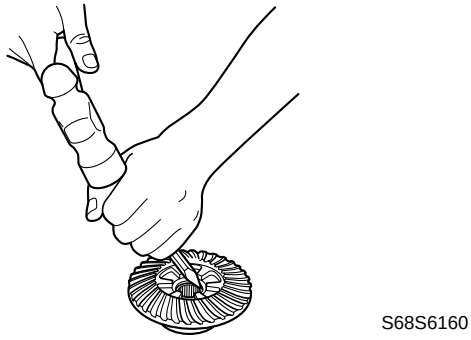
1. Remove the taper roller bearing from the forward gear using a press.



CAUTION:
Do not reuse the bearing, always replace it with a new one.

Bearing separator ①: 90890-06534

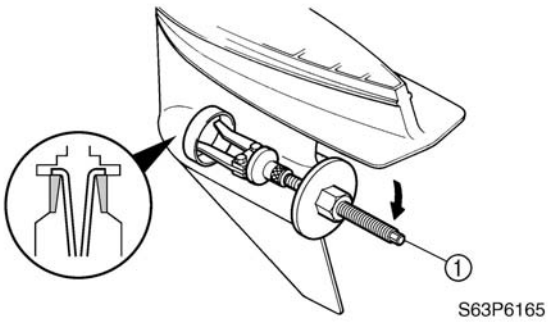
2. Remove the needle bearings from the forward gear using a chisel.



CAUTION:
Do not reuse the bearing, always replace it with a new one.

Disassembling the lower case

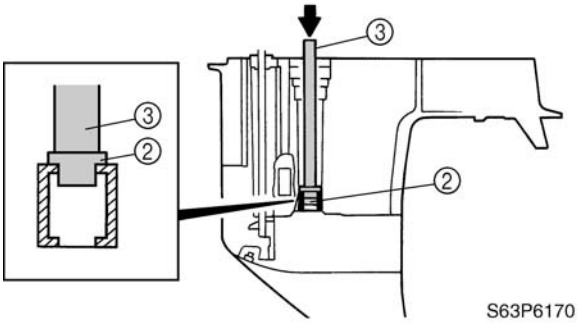
1. Remove the taper roller bearing outer race and shim(s).



NOTE:
Install the claws as shown.

	Bearing outer race puller assembly ①: 90890-06523

2. Remove the needle bearing.

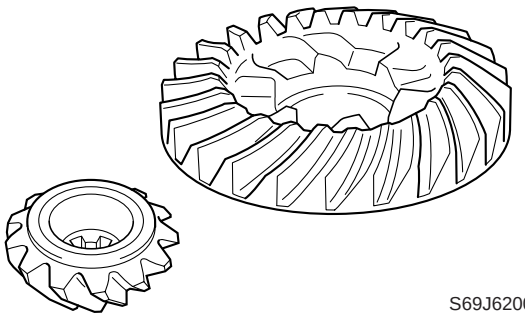


S63P6170

	Ball bearing attachment ②: 90890-06636 Driver rod LL ③: 90890-06605

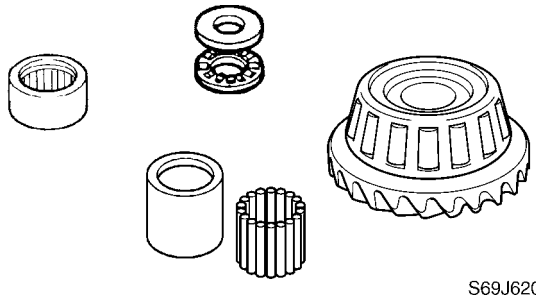
Checking the pinion and forward gear

1. Check the teeth of the pinion, and the teeth and dogs of the forward gear for cracks or wear. Replace if necessary.


S69J6200

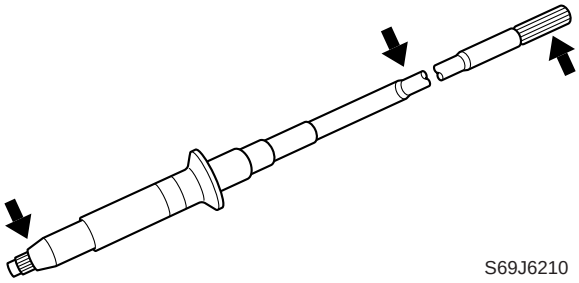
Checking the bearings

1. Check the bearings for pitting or rumbling. Replace if necessary.


S69J6205

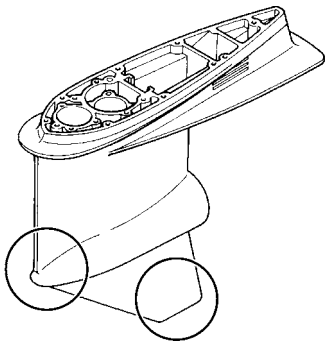
Checking the drive shaft

1. Check the drive shaft for bends or wear. Replace if necessary.


S69J6210

Checking the lower case

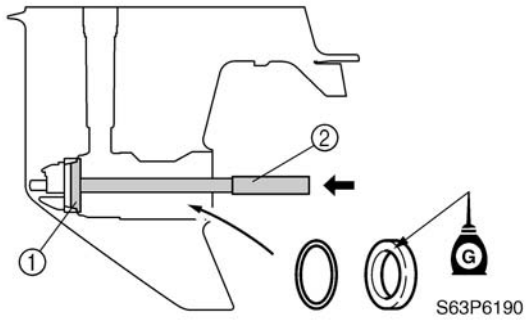
1. Check the skeg and torpedo for cracks or damage. Replace the lower case if necessary.


S60V6220

6

Assembling the lower case

1. Install the original shim(s) and taper roller bearing outer race.

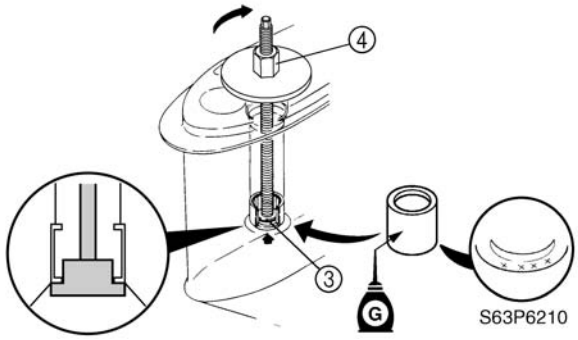


CAUTION:

Add or remove shim(s), if necessary, if replacing the forward gear or lower case.

Bearing outer race attachment ①:
90890-06619
Driver rod LL ②: 90890-06605

2. Install the needle bearing outer case into the lower case.



NOTE:

Apply gear oil to the needle bearing outer case before installation.

Ball bearing attachment ③:
90890-06633
Bearing outer race puller assembly ④:
90890-06523

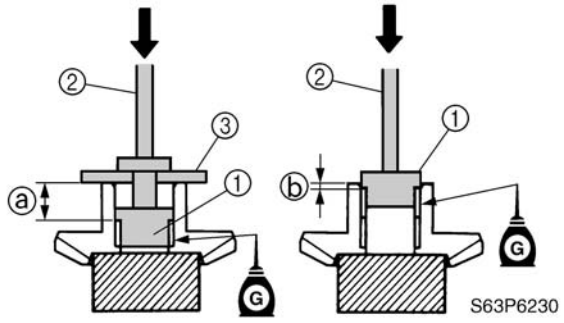
3. Install the needle bearing into the needle bearing outer case.

NOTE:

Apply gear oil or grease to the needle bearing before installation.

Assembling the forward gear

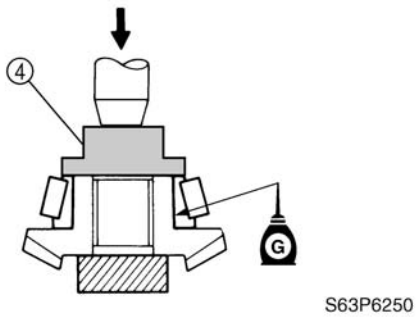
1. Install new needle bearings into the forward gear to the specified depth.



Needle bearing attachment ①:
90890-06612
Driver rod SS ②: 90890-06604
Bearing depth plate ③: 90890-06603

Depth ⓐ:
20.95–21.45 mm (0.825–0.844 in)
Depth ⓑ:
4.45–4.95 mm (0.175–0.195 in)

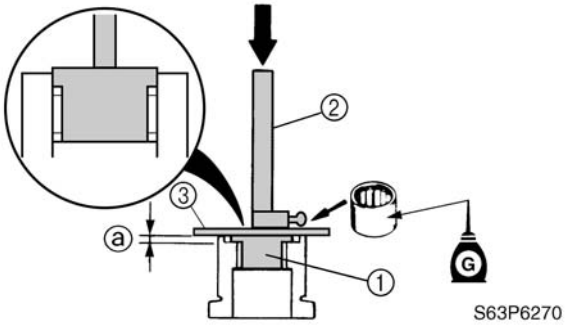
2. Install a new taper roller bearing into the forward gear using a press.



Needle bearing attachment ④:
90890-06654

Assembling the drive shaft housing

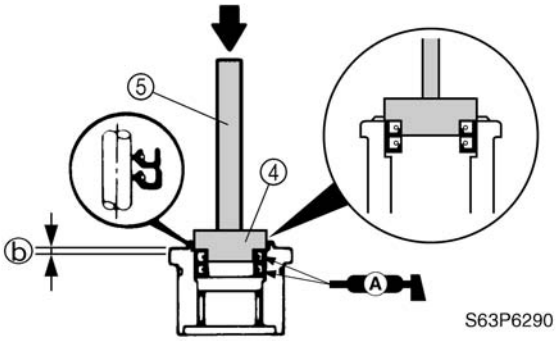
1. Install the needle bearing into the drive shaft housing to the specified depth.



Needle bearing attachment ①:
90890-06610
Driver rod SS ②: 90890-06604
Bearing depth plate ③: 90890-06603

Depth ⓐ:
5.75–6.25 mm (0.226–0.246 in)

2. Apply grease to a new oil seals, and then install them into the drive shaft housing to the specified depth.



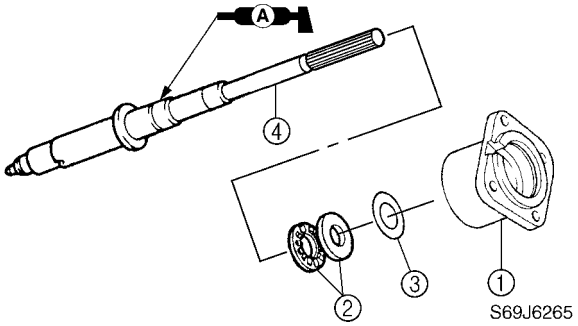
NOTE:
Install an oil seal halfway into the drive shaft housing, then the other oil seal.

Ball bearing attachment ④:
90890-06633
Driver rod LS ⑤: 90890-06606

Depth ⓑ:
0.25–0.75 mm (0.010–0.030 in)

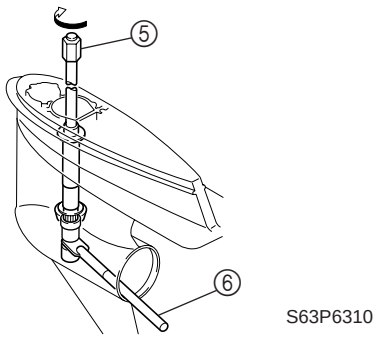
Installing the drive shaft

1. Install the forward gear into the lower case.
2. Install the drive shaft housing ①, thrust bearing ②, and original shim(s) ③ onto the drive shaft ④.



CAUTION:
Add or remove shim(s), if necessary, if replacing the drive shaft housing or drive shaft.

3. Install the sleeve, drive shaft and drive shaft housing into the lower case, then the pinion and pinion nut, and then tighten the nut to the specified torque.



NOTE:
Install the drive shaft by lifting it up slightly, then aligning it with the pinion and the spline of the drive shaft.

Drive shaft holder 6 ⑤: 90890-06520
Pinion nut holder ⑥:
New: 90890-06715
Current: 90890-06505

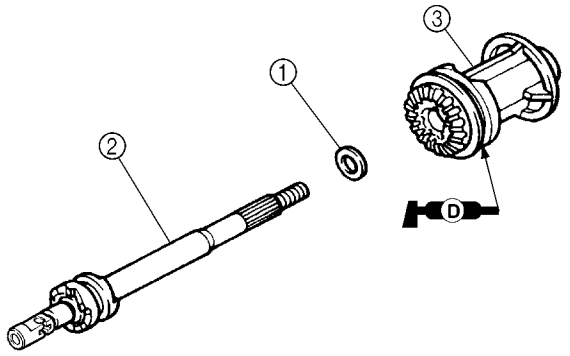
Pinion nut:
93 N·m (9.3 kgf·m, 68.6 ft·lb)

4. Tighten the drive shaft housing bolts.

Installing the propeller shaft housing

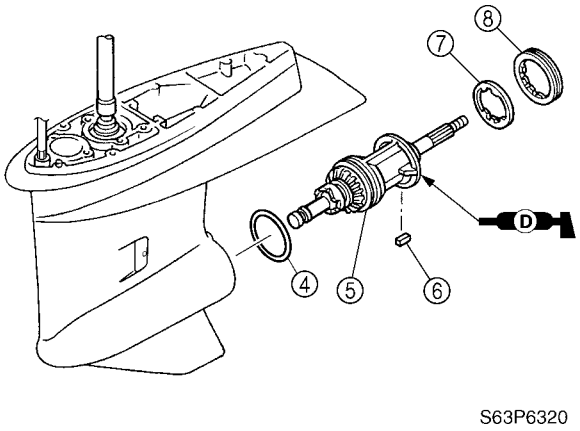
1. Install the washer ① and propeller shaft assembly ② into the propeller shaft housing assembly ③.

2. Apply grease to a new O-ring, and then install it onto the propeller shaft housing.



S63P6315

3. Install the original shim(s) ④ and propeller shaft housing assembly ⑤ into the lower case, and then install the straight key ⑥, claw washer ⑦, and ring nut ⑧.

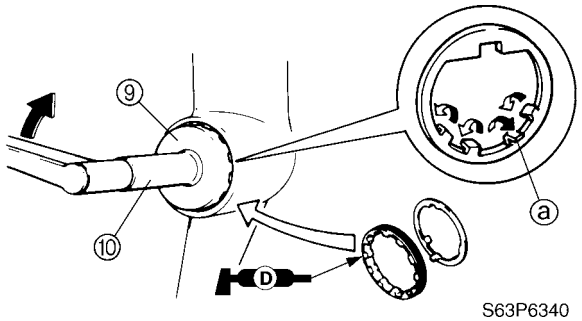


S63P6320

CAUTION:

Add or remove shim(s), if necessary, if replacing the reverse gear, ball bearing, propeller shaft housing, thrust washer, or lower case.

4. Tighten the ring nut to the specified torque.



S63P6340

NOTE:

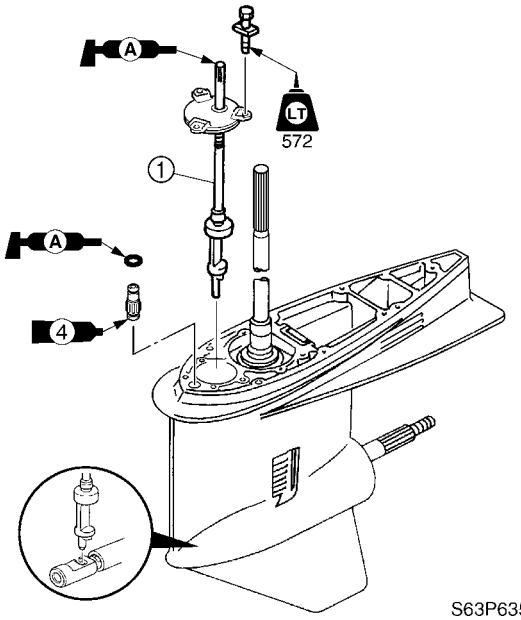
- To secure the ring nut, bend one tab ⓐ of the claw washer into a slot in the ring nut.
- Bend all other tabs toward the propeller shaft housing assembly.

Ring nut wrench 4 ⑨: 90890-06512
Ring nut wrench extension ⑩: 90890-06513

Ring nut ⑧:
142 N·m (14.2 kgf·m, 104.7 ft·lb)

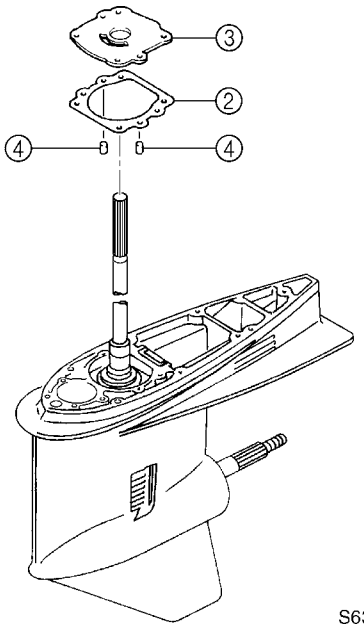
Installing the water pump and shift rod

1. Install the shift rod assembly ①.



S63P6350

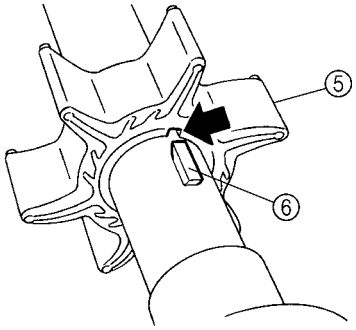
2. Install a new gasket ②, the outer plate cartridge ③, and dowels ④.



S63P6970

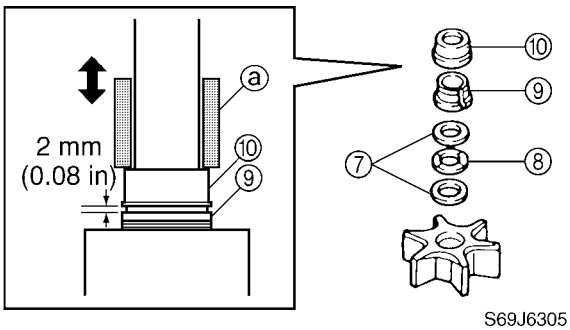
3. Install the Woodruff key into the drive shaft.

4. Align the groove in the impeller ⑤ with the Woodruff key ⑥, and then install the impeller onto the drive shaft.



S69J6300

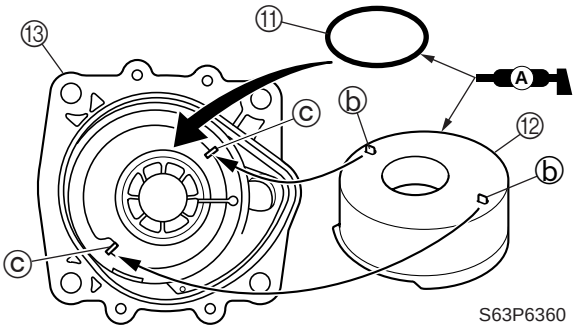
5. Install the washers ⑦, wave washer ⑧, spacer ⑨, and collar ⑩ onto the drive shaft.



S69J6305

NOTE:
- The collar and spacer should fit together firmly.
- While pulling the drive shaft up, install the collar with an appropriate tool ⓐ that fits over the drive shaft as shown.

6. Install the new O-ring ⑪ and insert cartridge ⑫ into the pump housing ⑬.

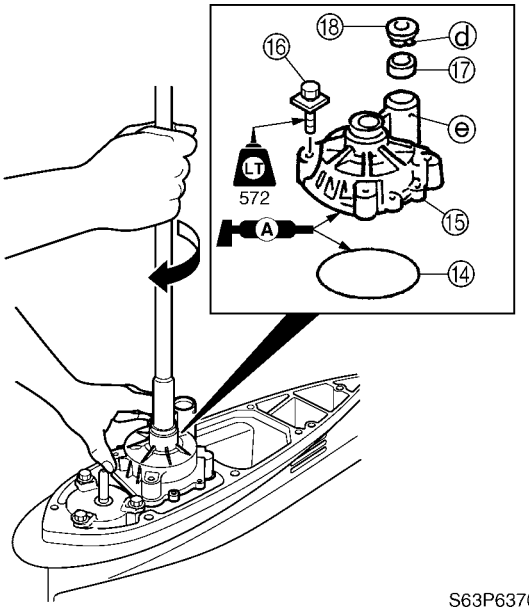


S63P6360

NOTE:
Align the insert cartridge projections ⓑ with the holes ⓒ in the pump housing.

6

7. Install the new O-ring ⑭ and pump housing assembly ⑮ into the lower case, tighten the bolts ⑯, and then install the seal ⑰ and cover ⑱.



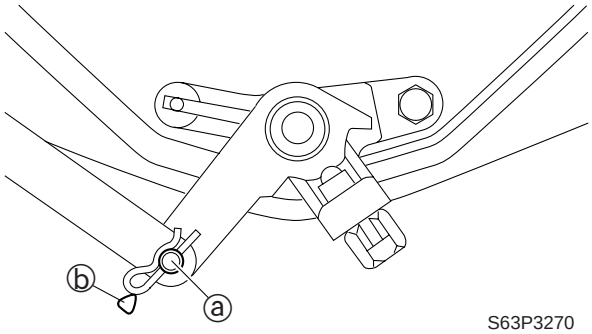
S63P6370

NOTE:
- When installing the pump housing, apply grease to the inside of the housing, and then turn the drive shaft clockwise while pushing down the pump housing.
- Align the cover projection ⓓ with the hole ⓔ in the pump housing.

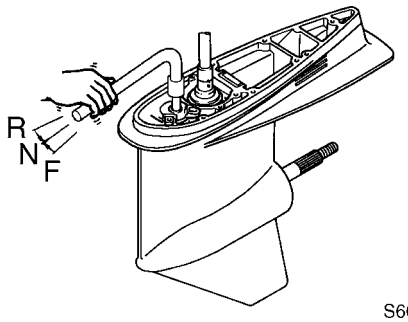
Installing the lower unit

1. Set the gear shift to the neutral position at the lower unit.

2. Align the center of the set pin ⓐ with the alignment mark ⓑ on the bottom cowling.



S63P3270



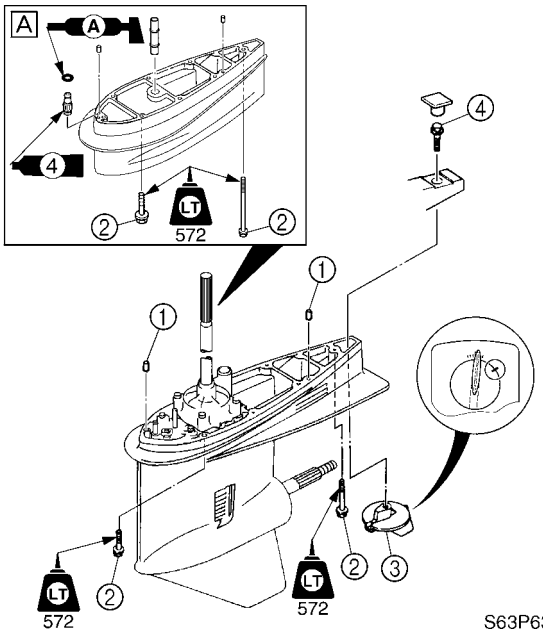
S60V6330

Shift rod push arm: 90890-06052

3. Install the two dowels ① into the lower unit.

4. Install the lower unit into the upper case, and then tighten the lower case mounting bolts ② to the specified torque.

5. Install the trim tab ③ to its original position, and then tighten the trim tab bolt ④ to the specified torque.

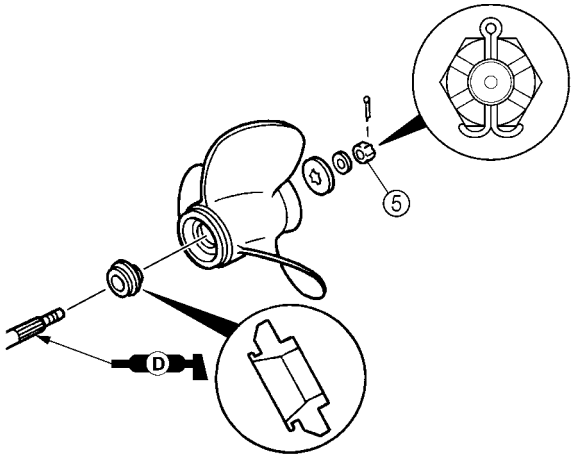


S63P6380

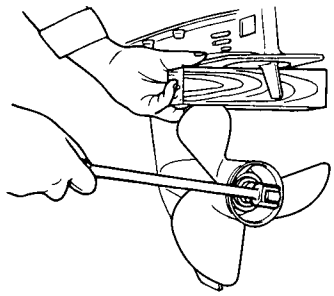
A X-transom model

Lower case mounting bolt ②:
47 N·m (4.7 kgf·m, 34.7 ft·lb)
Trim tab bolt ④:
42 N·m (4.2 kgf·m, 31.0 ft·lb)

6. Install the propeller and propeller nut, and then tighten the nut finger tight. Place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then tighten the nut to the specified torque.



S60V6650



S69J6340

	Propeller nut ⑤: 52 N·m (5.2 kgf·m, 38.4 ft·lb)

⚠ WARNING

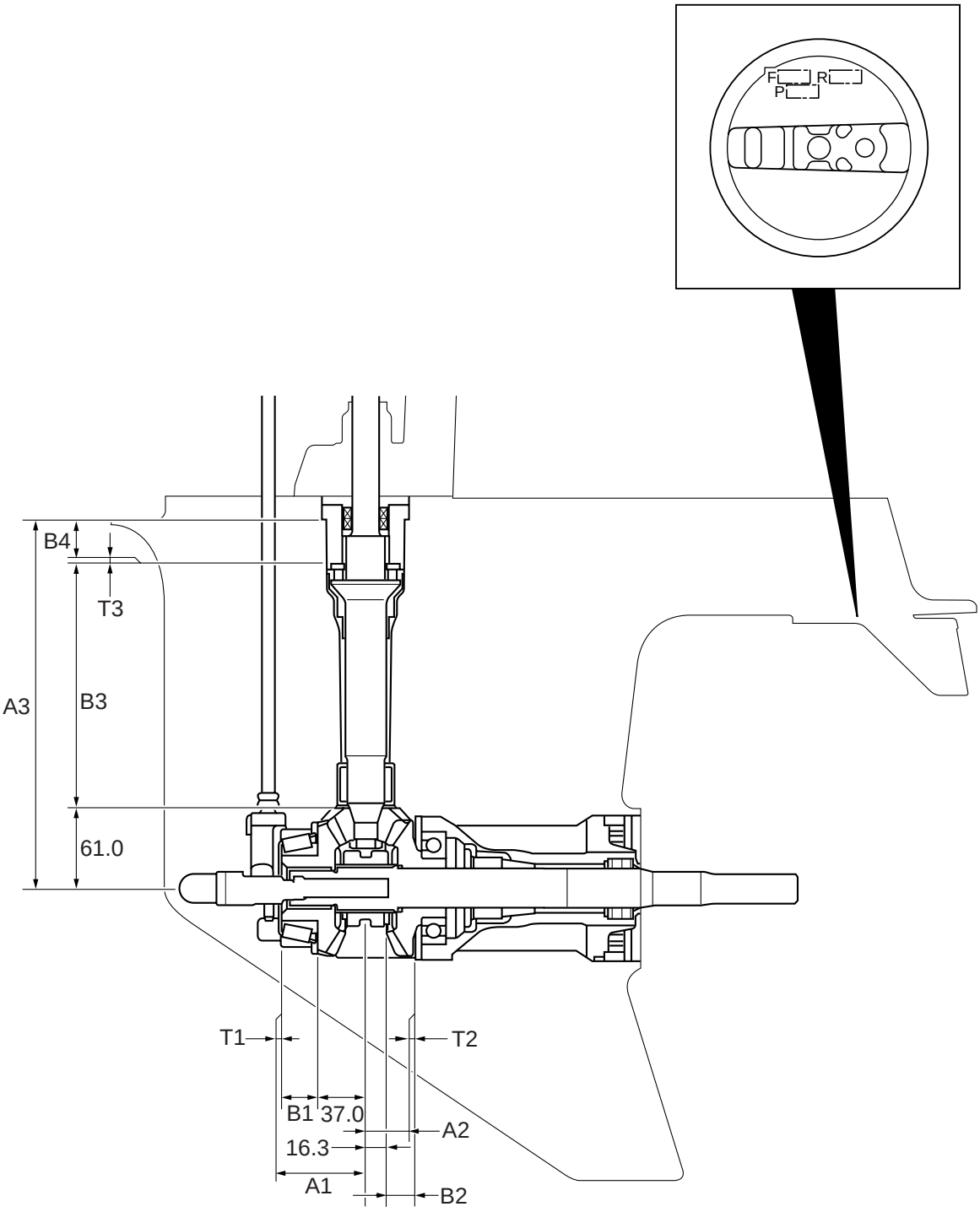
- **Do not hold the propeller with your hands when loosening or tightening it.**
- **Be sure to disconnect the battery leads from the battery and the engine stop lanyard from the engine stop lanyard switch.**
- **Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**

NOTE:

If the grooves in the propeller nut ⑤ do not align with the cotter pin hole, tighten the nut until they are aligned.

6

Shimming (regular rotation model)



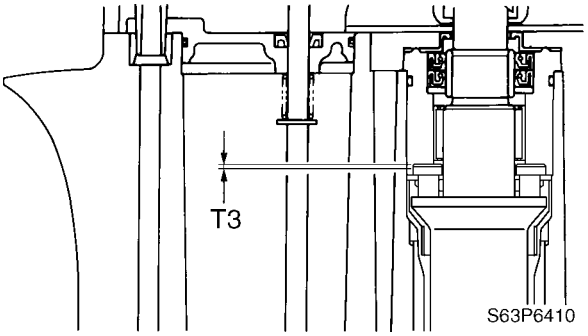
S63P6390

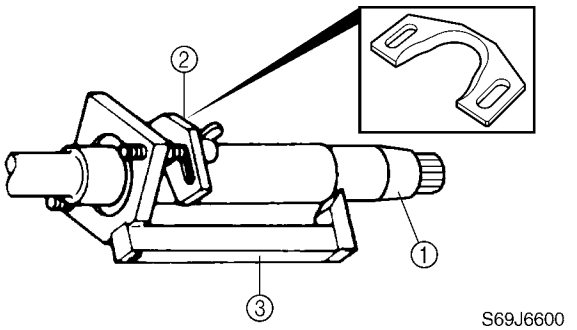
Shimming

NOTE:
- Shimming is not required when assembling the original lower case and inner parts.
- Shimming is required when assembling the original inner parts and a new lower case.
- Shimming is required when replacing the inner part(s).

Selecting the pinion shims

1. Install the special service tools onto the drive shaft ①.





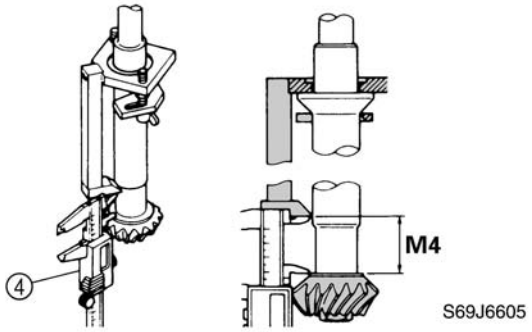
NOTE:
- Select the shim thickness (T3) by using the specified measurement(s) and the calculation formula.
- Install the special service tool onto the drive shaft so that the shaft is at the center of the hole.
- Tighten the wing nuts another 1/4 of a turn after they contact the fixing plate ②.

Pinion height gauge ③:
90890-06710

2. Install the pinion and pinion nut, and then tighten the nut to the specified torque.

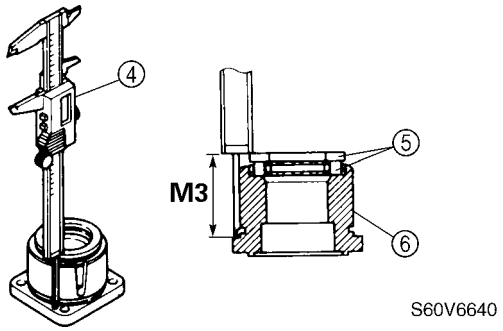
Pinion nut:
93 N·m (9.3 kgf·m, 68.6 ft·lb)

3. Measure the distance (M4) between the special service tool and the pinion as shown.



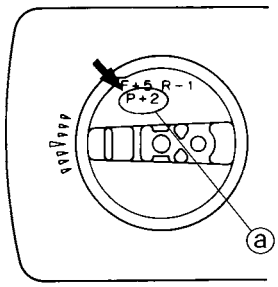
Digital caliper ④: 90890-06704

4. Turn the thrust bearing ⑤ two or three times to seat the drive shaft housing ⑥, and then measure the housing height (M3) as shown.



NOTE:
Measure the thrust bearing at three points to find the height average.

5. Calculate the pinion shim thickness (T3) as shown in the examples below.



S69J6555

NOTE:
"P" is the deviation of the lower case dimension from standard. The "P" mark ⓐ is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "P" mark is unreadable, assume that "P" is zero and check the backlash when the unit is assembled.

Calculation formula:
Pinion shim thickness (T3) =
80.00 + P/100 – M3 – M4

Example:
If "M3" is 46.68 mm and "M4" is 32.49 mm and "P" is (–5), then
T3 = 80.00 + (–5)/100 – 46.68 – 32.49 mm
= 80.00 – 0.05 – 46.68 – 32.49 mm
= 0.78 mm

6. Select the pinion shim(s) (T3) as follows.

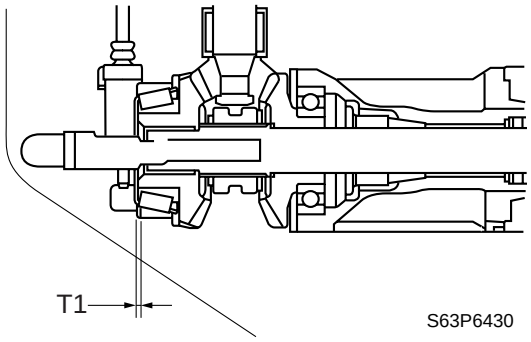
Calculated numeral at 1/100 place	Rounded numeral
1, 2	0
3, 4, 5	2
6, 7, 8	5
9, 10	8

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

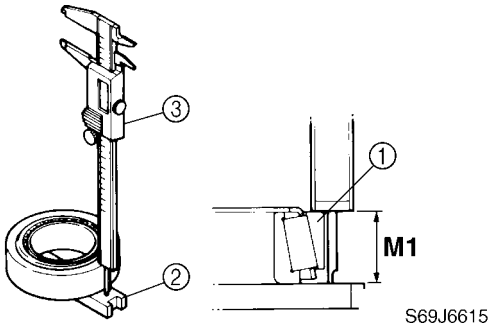
Example:
If "T3" is 0.53 mm, then the pinion shim is 0.52 mm.
If "T3" is 0.78 mm, then the pinion shim is 0.75 mm.

Selecting the forward gear shims

1. Turn the taper roller bearing outer race ① two or three times to seat the rollers, and then measure the bearing height (M1) as shown.



S63P6430

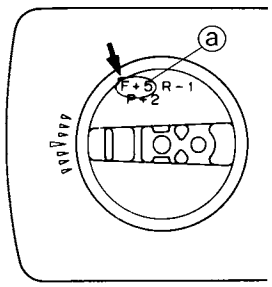


S69J6615

NOTE:
- Select the shim thickness (T1) by using the specified measurement(s) and the calculation formula.
- Measure the bearing outer race at three points to find the height average.

Shimming plate ②: 90890-06701
Digital caliper ③: 90890-06704

2. Calculate the forward gear shim thickness (T1) as shown in the examples below.



S69J6570

NOTE:
"F" is the deviation of the lower case dimension from standard. The "F" mark ⓐ is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "F" mark is unreadable, assume that "F" is zero and check the backlash when the unit is assembled.

Calculation formula:
Forward gear shim thickness (T1) =
28.60 + F/100 – M1

Example:
If "M1" is 28.08 mm and "F" is (+5), then
T1 = 28.60 + (+5)/100 – 28.08 mm
= 28.60 + 0.05 – 28.08 mm
= 0.57 mm

3. Select the forward gear shim(s) (T1) as follows.

Calculated numeral at 1/100 place	Rounded numeral
1, 2	0
3, 4, 5	2
6, 7, 8	5
9, 10	8

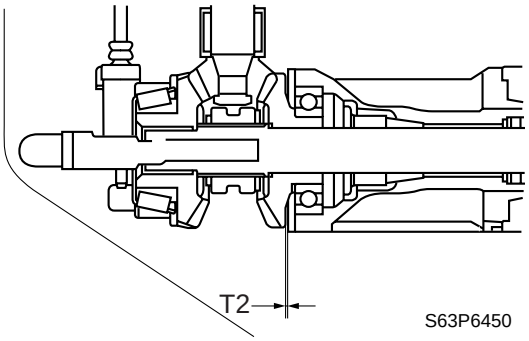
Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

Example:
If "T1" is 0.57 mm, then the forward gear shim is 0.55 mm.
If "T1" is 0.60 mm, then the forward gear shim is 0.58 mm.

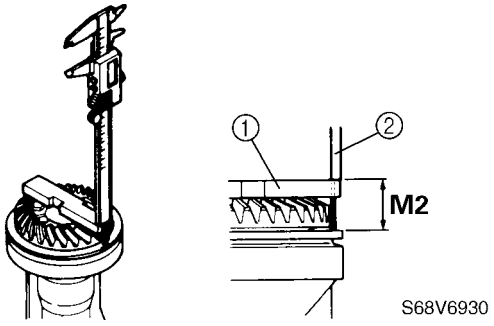
Selecting the reverse gear shims

1. Install the ball bearing, thrust washer, and reverse gear onto the propeller shaft housing.

2. Measure the gear height (M2) from the thrust washer on the propeller shaft housing.



S63P6450



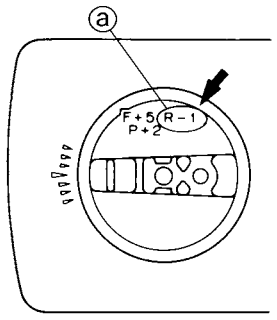
S68V6930

NOTE:
- Select the shim thickness (T2) by using the specified measurement(s) and the calculation formula.
- Measure the reverse gear at three points to find the height average.

Shimming plate ①: 90890-06701
Digital caliper ②: 90890-06704

6

3. Calculate the reverse gear shim thickness (T2) as shown in the examples below.



S69J6585

NOTE:
"R" is the deviation of the lower case dimension from standard. The "R" mark ⓐ is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "R" mark is unreadable, assume that "R" is zero and check the backlash when the unit is assembled.

Calculation formula:
Reverse gear shim thickness (T2) =
M2 – 29.90 – R/100

Example:
If "M2" is 30.70 mm and "R" is (+3), then
T2 = 30.70 – 29.90 – (+3)/100 mm
= 30.70 – 29.90 – 0.03 mm
= 0.77 mm

4. Select the reverse gear shim(s) (T2) as follows.

Calculated numeral at 1/100 place	Rounded numeral
1, 2	2
3, 4, 5	5
6, 7, 8	8
9, 10	10

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

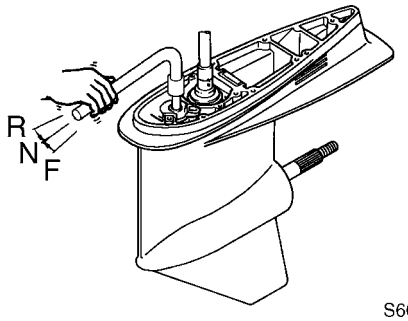
Example:
If "T2" is 0.77 mm, then the reverse gear shim is 0.78 mm.
If "T2" is 0.79 mm, then the reverse gear shim is 0.80 mm.

Backlash (regular rotation model)

Measuring the forward and reverse gear backlash

1. Remove the water pump assembly.

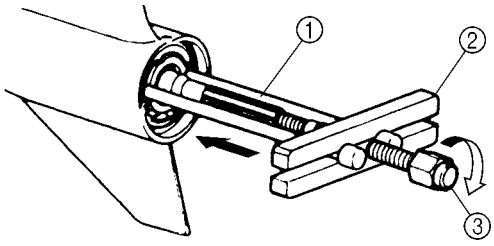
2. Set the gear shift to the neutral position at the lower unit.



S60V6330

Shift rod push arm: 90890-06052

3. Install the special service tools so that it pushes against the propeller shaft.



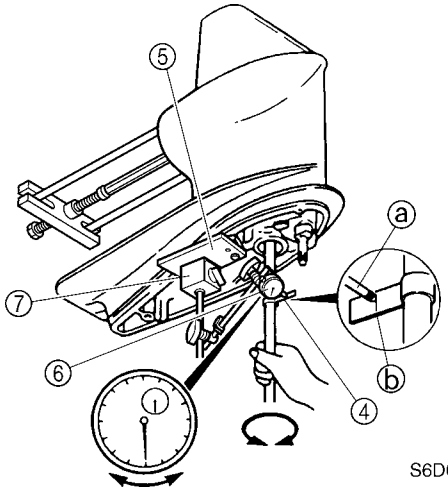
S60X6370

NOTE:
Tighten the center bolt while turning the drive shaft until the drive shaft can no longer be turned.

Bearing housing puller claw L ①: 90890-06502
Stopper guide plate ②: 90890-06501
Center bolt ③: 90890-06504

4. Install the backlash indicator onto the drive shaft (22.4 mm [0.88 in] in diameter), then the dial gauge onto the lower unit.

5. Set the lower unit upside down.



NOTE:
Install the dial gauge so that the plunger ⓐ contacts the mark ⓑ on the backlash indicator.

Backlash indicator ④: 90890-06706
Magnet base plate ⑤: 90890-07003
Dial gauge set ⑥: 90890-01252
Magnet base B ⑦: 90890-06844

6. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.

Forward gear backlash:
0.14–0.46 mm (0.0055–0.0181 in)

7. Add or remove shim(s) if out of specification.

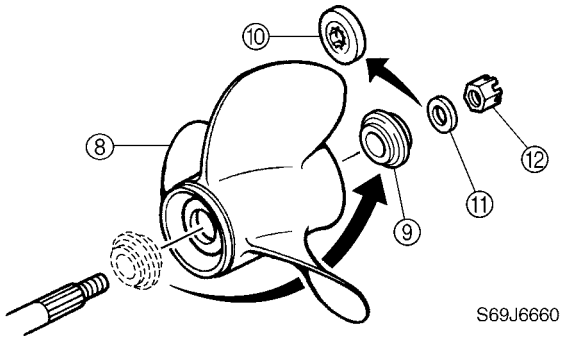
Forward gear backlash	Shim thickness
Less than 0.14 mm (0.0055 in)	To be decreased by (0.30 – M) × 0.67
More than 0.46 mm (0.0181 in)	To be increased by (M – 0.30) × 0.67

M: Measurement

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

8. Remove the special service tools from the propeller shaft.

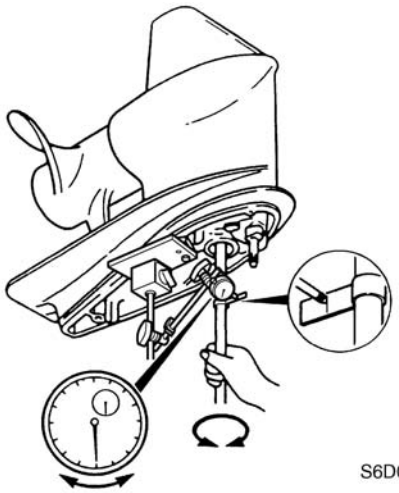
9. Apply a load to the reverse gear by installing the propeller ⑧, the spacer ⑨ (without the washer ⑩), then the washer ⑪ as shown.



NOTE:
Tighten the propeller nut ⑫ while turning the drive shaft until the drive shaft can no longer be turned.

6

10. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.



Reverse gear backlash:
0.32–0.67 mm (0.0126–0.0264 in)

11. Add or remove shim(s) if out of specification.

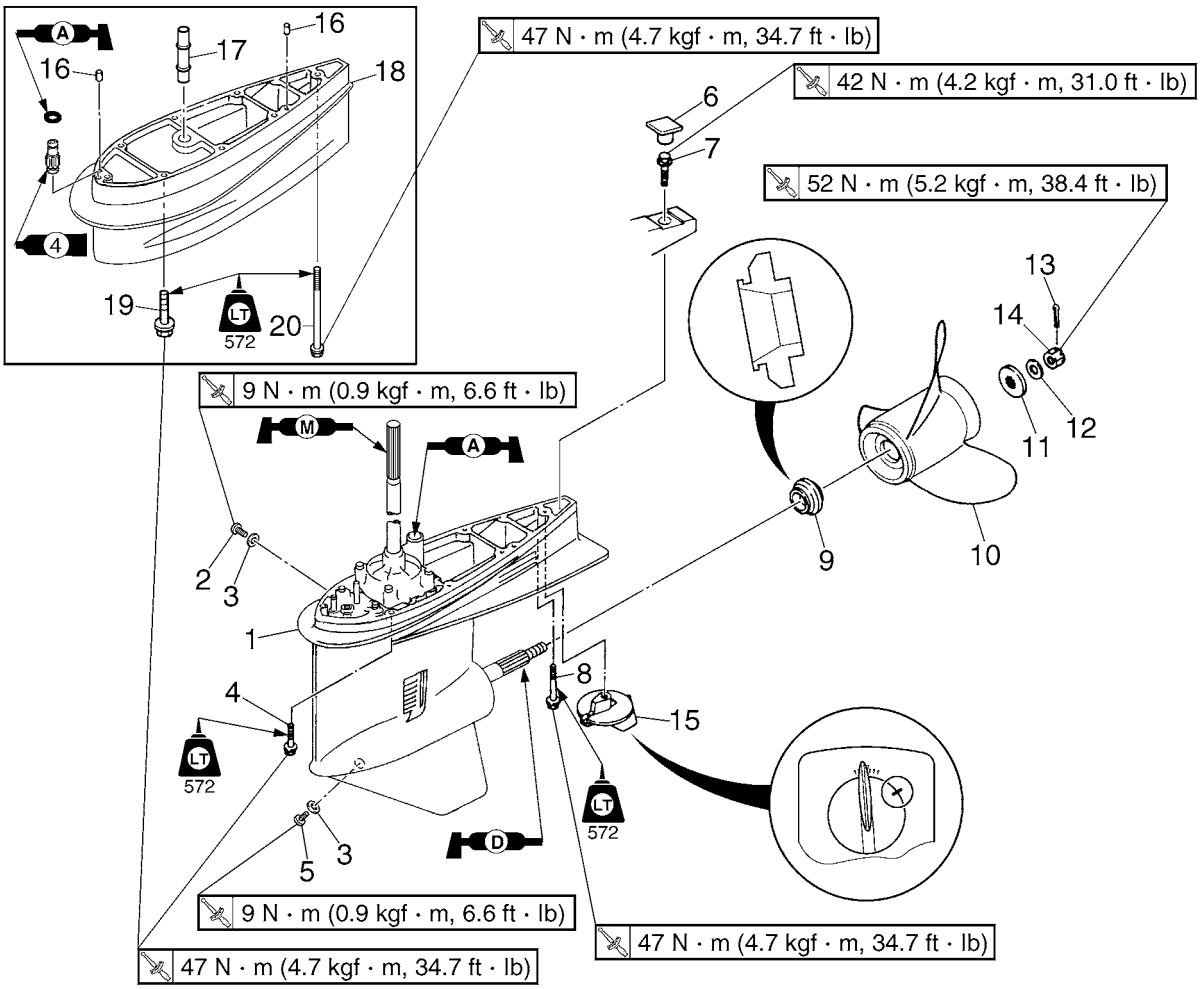
Reverse gear backlash	Shim thickness
Less than 0.32 mm (0.0126 in)	To be increased by (0.50 – M) × 0.67
More than 0.67 mm (0.0264 in)	To be decreased by (M – 0.50) × 0.67

M: Measurement

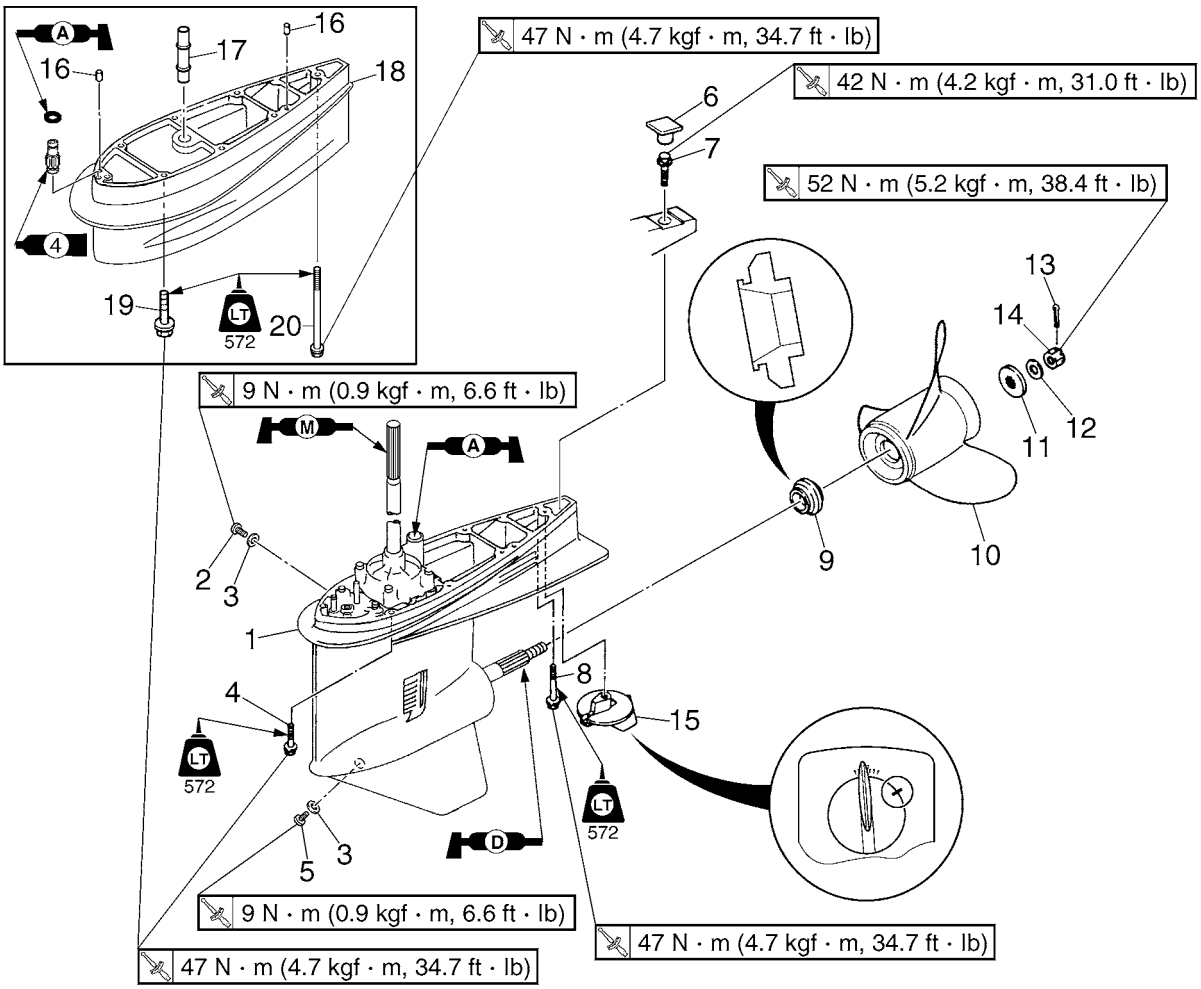
Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

12. Remove the special service tools, and then install the water pump assembly.

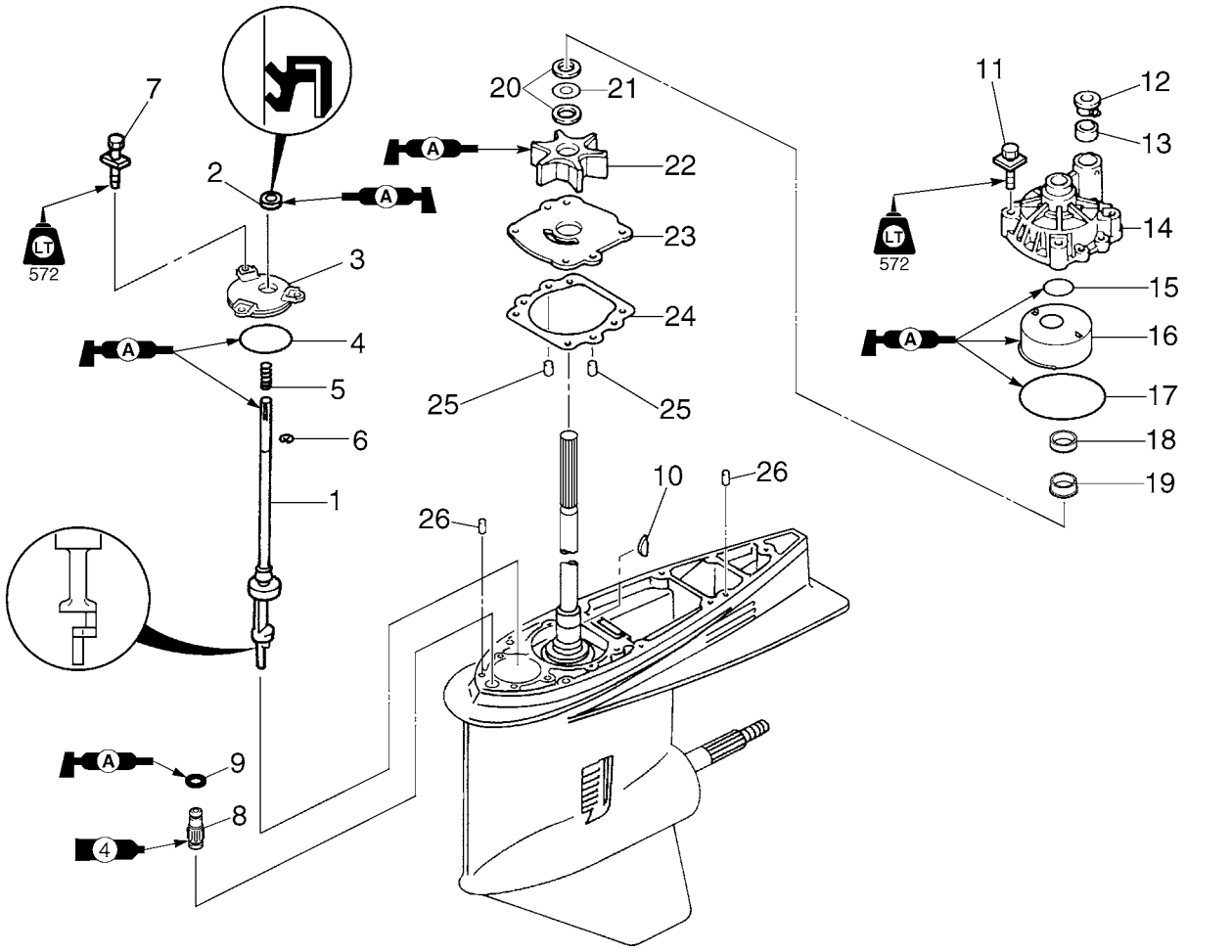
Lower unit (counter rotation model)


47 N · m (4.7 kgf · m, 34.7 ft · lb)
42 N · m (4.2 kgf · m, 31.0 ft · lb)
52 N · m (5.2 kgf · m, 38.4 ft · lb)
9 N · m (0.9 kgf · m, 6.6 ft · lb)
9 N · m (0.9 kgf · m, 6.6 ft · lb)
47 N · m (4.7 kgf · m, 34.7 ft · lb)
47 N · m (4.7 kgf · m, 34.7 ft · lb)
572
572
572
S63P6460

No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Check screw	1	
3	Gasket	2	**Not reusable**
4	Bolt	6	M10 × 45 mm
5	Drain screw	1	
6	Grommet	1	
7	Bolt	1	M10 × 44 mm
8	Bolt	1	M10 × 70 mm / L-transom model (for Europe)
9	Spacer	1	
10	Propeller	1	
11	Washer	1	
12	Washer	1	
13	Cotter pin	1	**Not reusable**
14	Propeller nut	1	
15	Trim tab	1	
16	Dowel	2	X-transom model
17	Water pipe	1	X-transom model

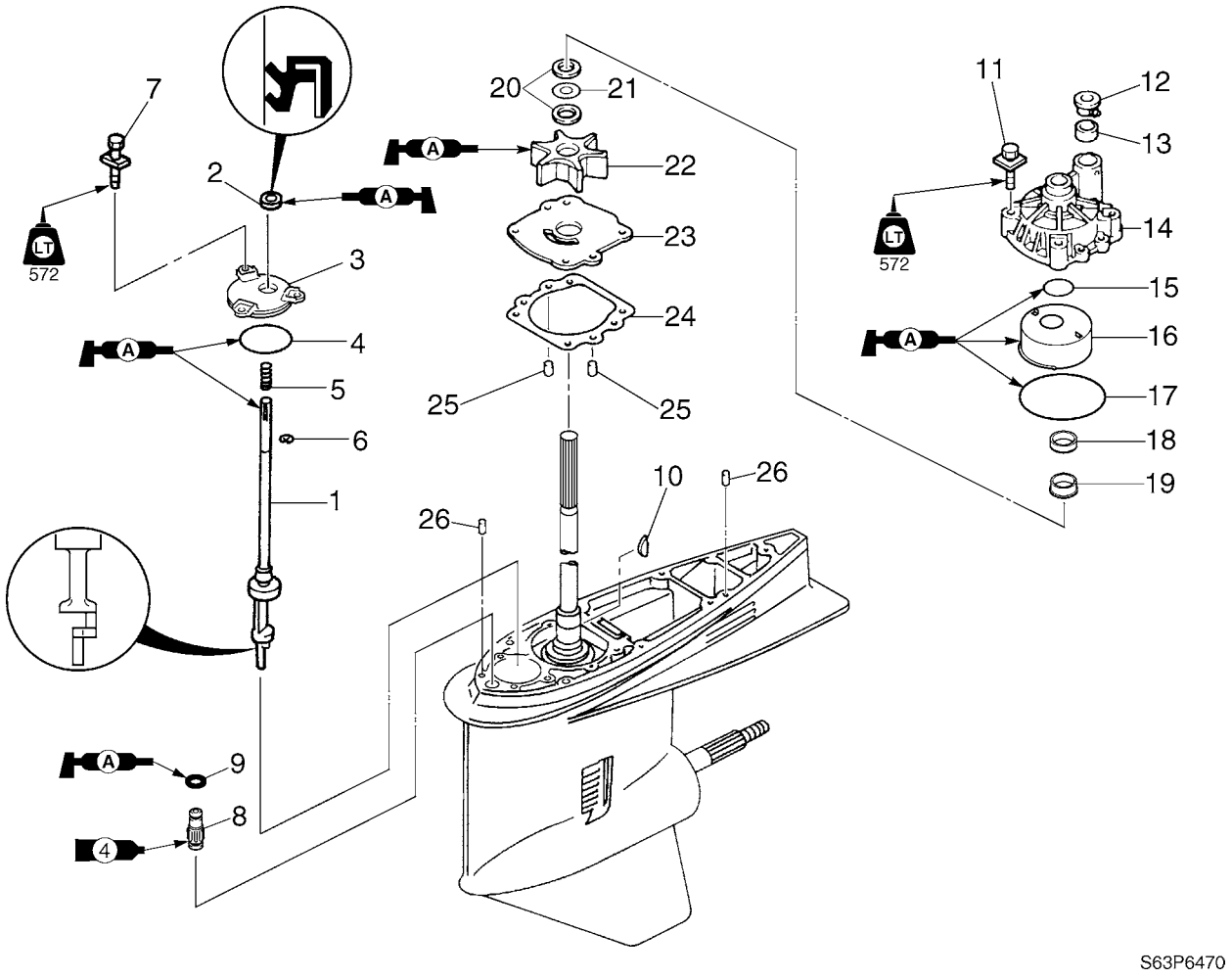

47 N · m (4.7 kgf · m, 34.7 ft · lb)
42 N · m (4.2 kgf · m, 31.0 ft · lb)
52 N · m (5.2 kgf · m, 38.4 ft · lb)
9 N · m (0.9 kgf · m, 6.6 ft · lb)
9 N · m (0.9 kgf · m, 6.6 ft · lb)
47 N · m (4.7 kgf · m, 34.7 ft · lb)
47 N · m (4.7 kgf · m, 34.7 ft · lb)
572
572
572
S63P6460

No.	Part name	Q'ty	Remarks
18	Extension	1	X-transom model
19	Bolt	6	M10 × 45 mm / X-transom model
20	Bolt	1	M10 × 200 mm / X-transom model



S63P6470

No.	Part name	Q'ty	Remarks
1	Shift rod	1	
2	Oil seal	1	**Not reusable**
3	Oil seal housing	1	
4	O-ring	1	**Not reusable**
5	Spring	1	
6	Circlip	1	
7	Bolt	3	M6 × 20 mm
8	Hose nipple	1	
9	O-ring	1	**Not reusable**
10	Woodruff key	1	
11	Bolt	4	M8 × 45 mm
12	Cover	1	
13	Seal	1	
14	Water pump housing	1	
15	O-ring	1	**Not reusable**
16	Insert cartridge	1	
17	O-ring	1	**Not reusable**



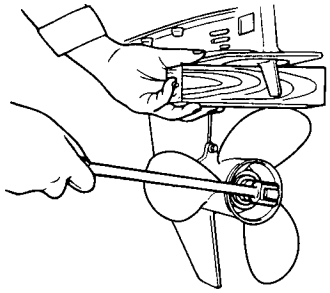
S63P6470

No.	Part name	Q'ty	Remarks
18	Collar	1	
19	Spacer	1	
20	Washer	2	
21	Wave washer	1	
22	Impeller	1	
23	Outer plate cartridge	1	
24	Gasket	1	**Not reusable**
25	Dowel	2	
26	Dowel	2	

Removing the lower unit

1. Drain the gear oil. For draining procedures, see Chapter 3, “Changing the gear oil.”

2. Set the gear shift to the neutral position, and place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then remove the propeller nut and propeller.



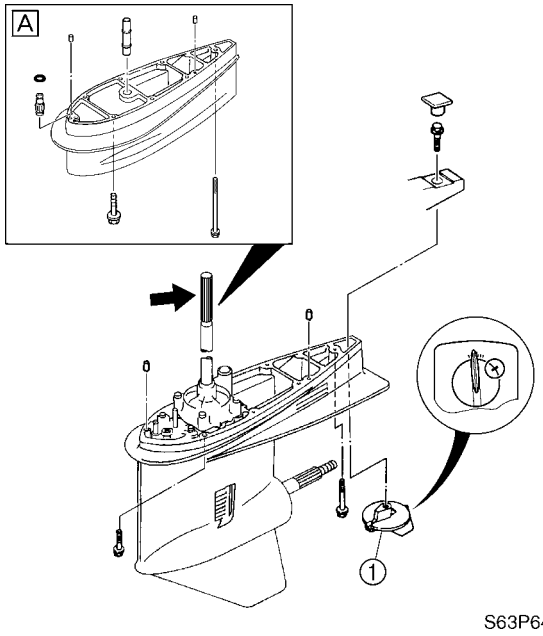
S69J6545

⚠ WARNING

- **Do not hold the propeller with your hands when loosening or tightening it.**
- **Be sure to disconnect the battery leads from the battery and the engine stop lanyard from the engine stop lanyard switch.**
- **Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**

3. Mark the trim tab ① at the area shown, and then remove it.

4. Loosen the bolts, and then remove the lower unit from the upper case.



S63P6480

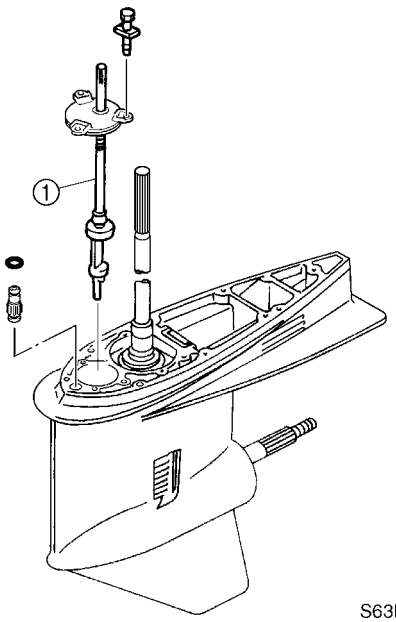
A X-transom model

NOTE:

Check that there is no oil on the spline and check it for wear.

Removing the water pump and shift rod

1. Remove the water pump assembly and shift rod assembly ①.

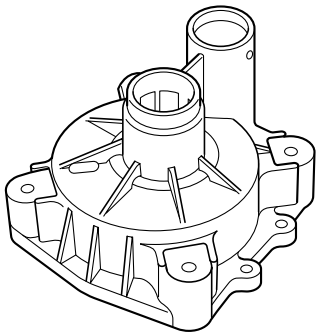


S63P6040

6

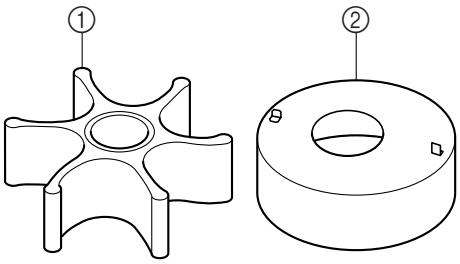
Checking the water pump and shift rod

1. Check the water pump housing for deformation. Replace if necessary.



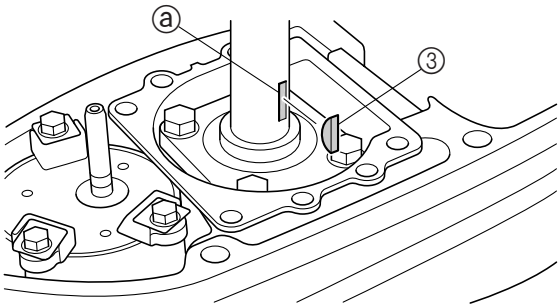
S69J6030

2. Check the impeller ① and insert cartridge ② for cracks or wear. Replace if necessary.



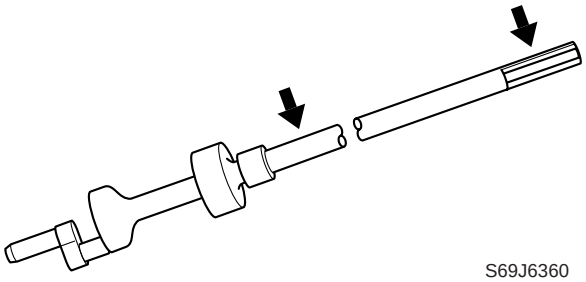
S63P6050

3. Check the Woodruff key ③ and the keyway ⓐ in the drive shaft for wear. Replace if necessary.



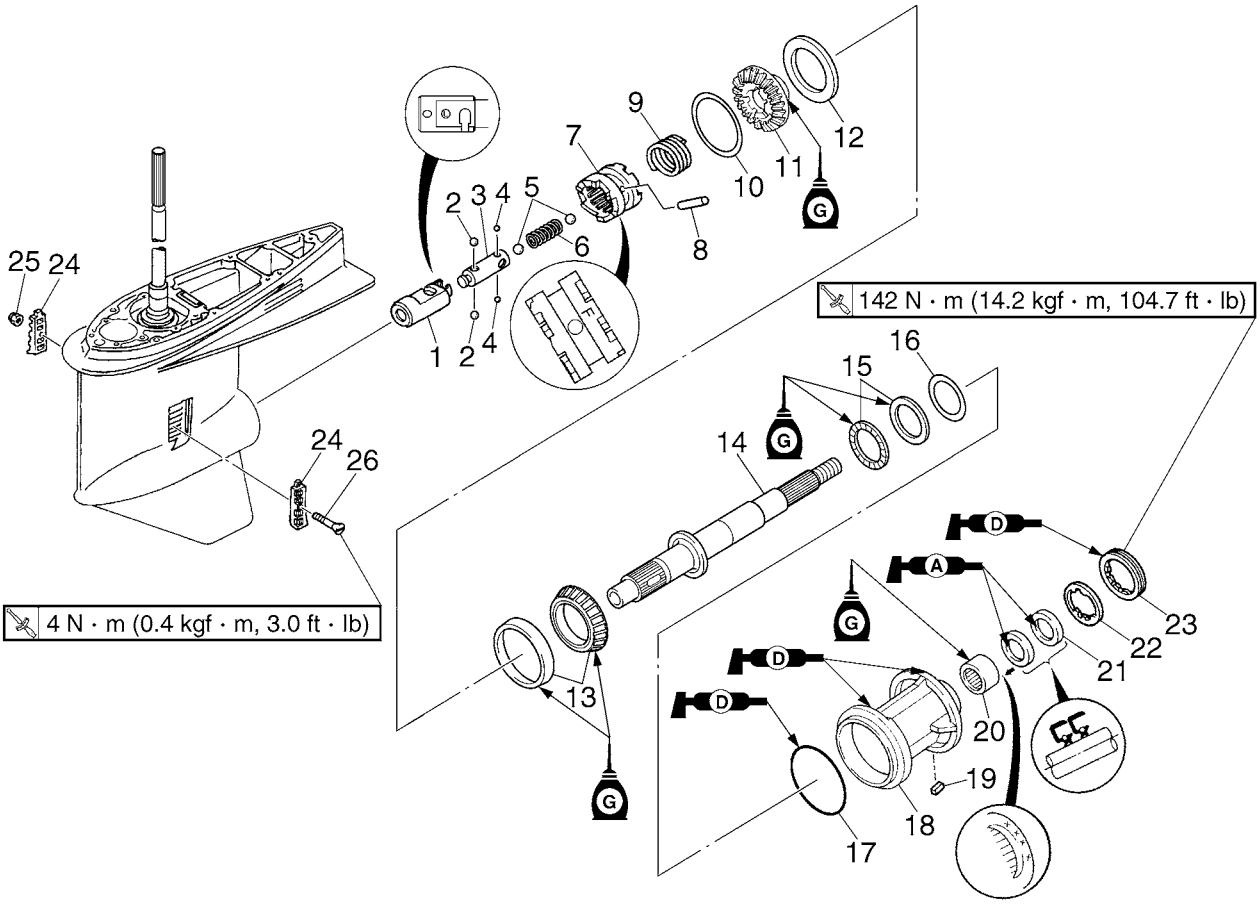
S69J6040

4. Check the shift rod for cracks or wear. Replace if necessary.

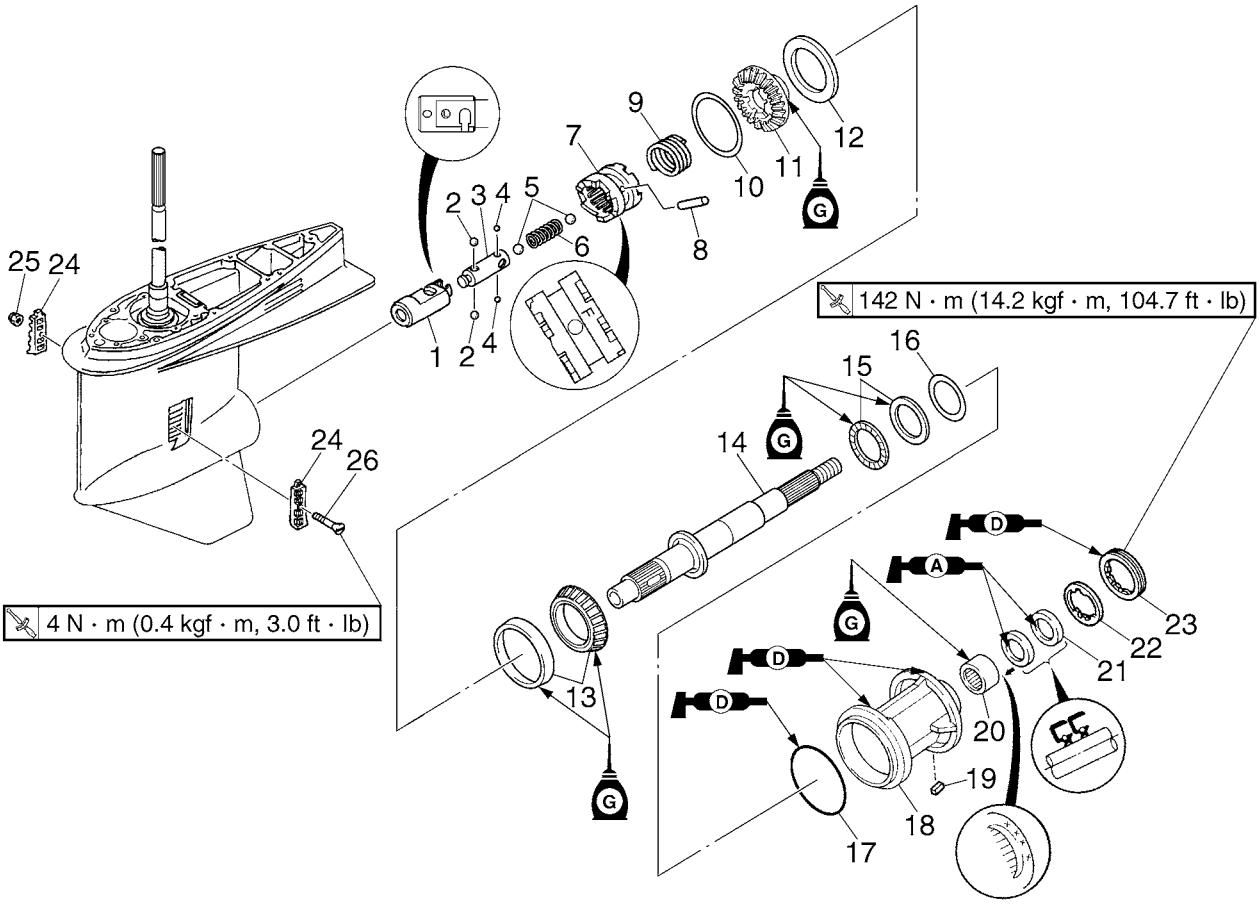


S69J6360

Propeller shaft housing (counter rotation model)



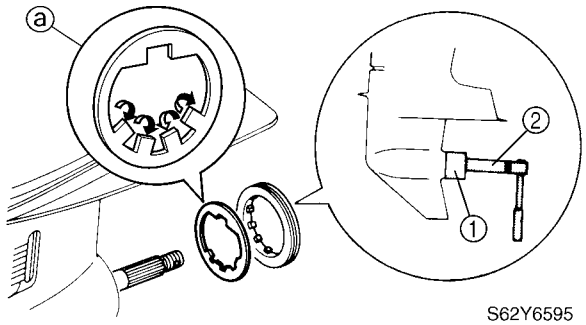
No.	Part name	Q'ty	Remarks
1	Shift rod joint	1	
2	Ball	2	
3	Shift slider	1	
4	Ball	2	
5	Ball	2	
6	Spring	1	
7	Dog clutch	1	
8	Cross pin	1	
9	Spring	1	
10	Forward gear shim	—	
11	Forward gear	1	
12	Thrust washer	1	
13	Taper roller bearing assembly	1	**Not reusable**
14	Propeller shaft	1	
15	Thrust bearing	1	
16	Propeller shaft shim	—	
17	O-ring	1	**Not reusable**



No.	Part name	Q'ty	Remarks
18	Propeller shaft housing	1	
19	Straight key	1	
20	Needle bearing	1	
21	Oil seal	2	**Not reusable**
22	Claw washer	1	
23	Ring nut	1	
24	Cooling water inlet cover	2	
25	Nut	1	
26	Screw	1	

Removing the propeller shaft housing assembly

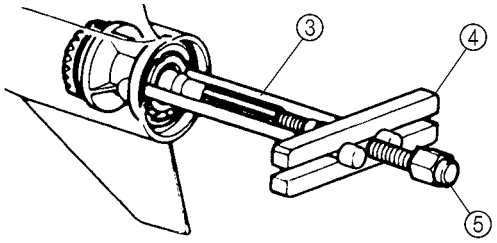
1. Straighten the claw washer tabs ⓐ, and then remove the ring nut and claw washer.



S62Y6595

Ring nut wrench 4 ①: 90890-06512
Ring nut wrench extension ②: 90890-06513

2. Pull out the propeller shaft housing assembly.



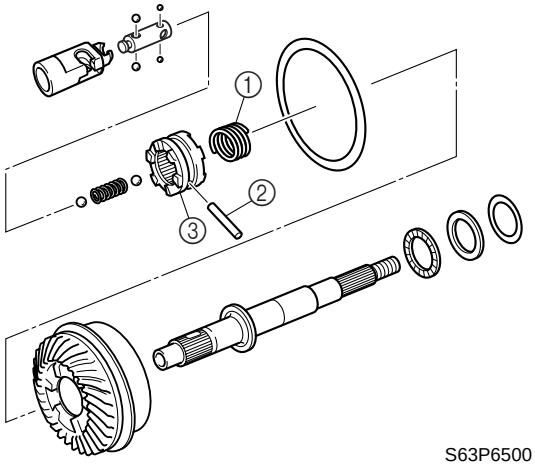
S68S6310

Bearing housing puller claw L ③: 90890-06502
Stopper guide plate ④: 90890-06501
Center bolt ⑤: 90890-06504

Disassembling the propeller shaft assembly

1. Remove the spring ①, then the cross pin ②, dog clutch ③, shift slider, balls, spring, and shift rod joint.

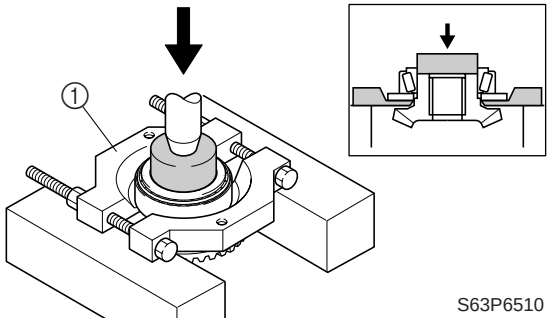
2. Remove the forward gear assembly.



S63P6500

Disassembling the forward gear

1. Remove the bearing outer race, taper roller bearing, and thrust washer from the forward gear.



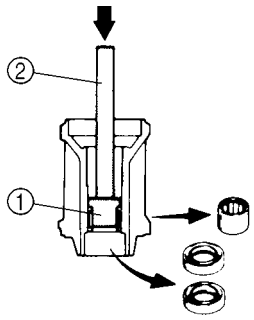
S63P6510

Bearing separator ①: 90890-06534

6

Disassembling the propeller shaft housing

1. Remove the oil seals and needle bearing.

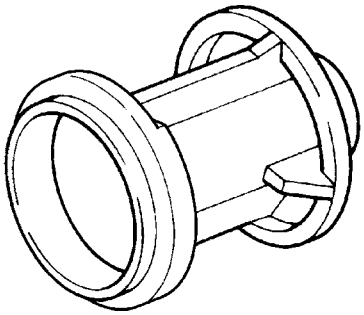


S63P6520

Needle bearing attachment ①: 90890-06653
Driver rod L3 ②: 90890-06652

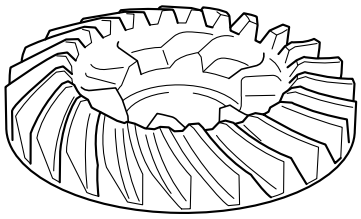
Checking the propeller shaft housing

1. Clean the propeller shaft housing using a soft brush and cleaning solvent, and then check it for cracks or damage. Replace if necessary.



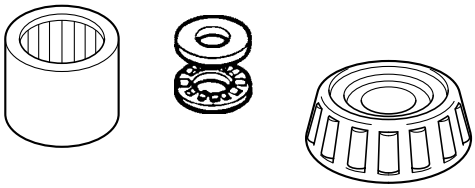
S62Y6650

2. Check the teeth and dogs of the forward gear for cracks or wear. Replace the gear if necessary.



S62Y6640

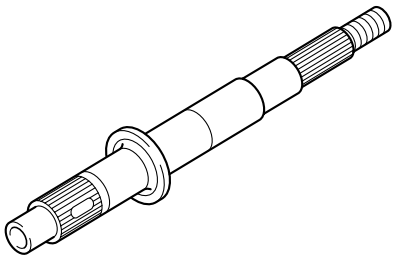
3. Check the bearings for pitting or rumbling. Replace if necessary.



S69J6410

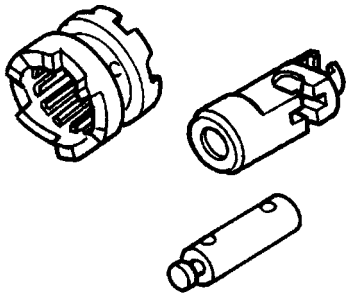
Checking the propeller shaft

1. Check the propeller shaft for bends or wear. Replace if necessary.



S69J6415

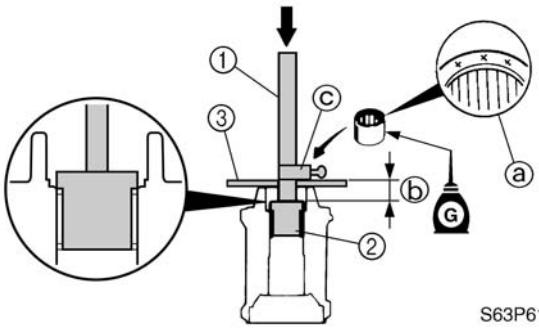
2. Check the dog clutch, shift rod joint, and shift slider for cracks or wear. Replace if necessary.



S69J6420

Assembling the propeller shaft housing

1. Install the needle bearing into the propeller shaft housing to the specified depth.



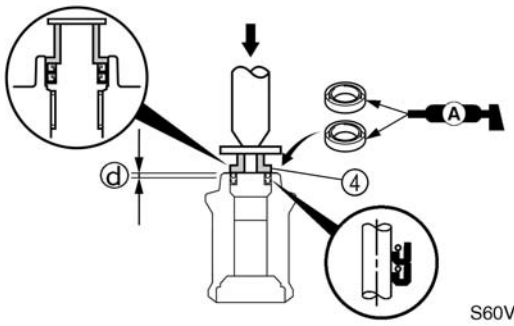
S63P6100

NOTE:
- Install the needle bearing with the manufacture identification mark ⓐ facing toward the oil seal (propeller side).
- When using the driver rod, do not strike the special service tool in a manner that will force the stopper ⓒ out of place.

Driver rod SS ①: 90890-06604
Needle bearing attachment ②: 90890-06610
Bearing depth plate ③: 90890-06603

Depth ⓑ: 24.75–25.25 mm (0.974–0.994 in)

2. Apply grease to new oil seals, and then install them into the propeller shaft housing to the specified depth.



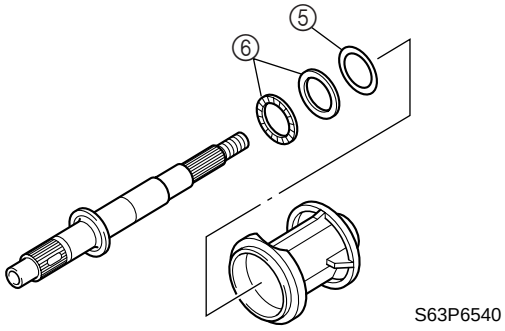
S60V6680

NOTE:
Install an oil seal halfway into the propeller shaft housing, then the other oil seal.

Bearing inner race attachment ④: 90890-06640

Depth ⓓ: 4.75–5.25 mm (0.187–0.207 in)

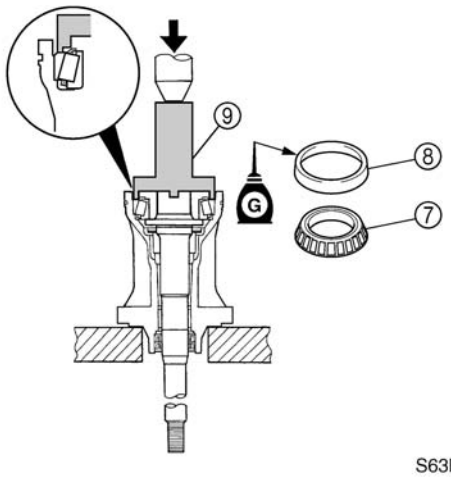
3. Install the original shim(s) ⑤ and thrust bearing ⑥ with the propeller shaft into the propeller shaft housing.



S63P6540

CAUTION:
Add or remove shim(s), if necessary, if replacing the propeller shaft, thrust bearing, or propeller shaft housing.

4. Install a new taper roller bearing ⑦ and the bearing outer race ⑧ into the propeller shaft housing using a press.

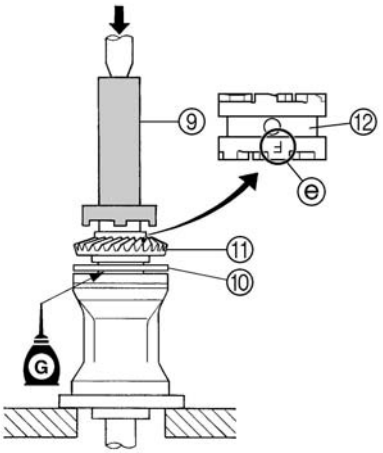


S63P6550

Ring nut wrench ⑨: 90890-06578

6

5. Install the thrust washer ⑩, forward gear ⑪, and dog clutch ⑫ using a press.

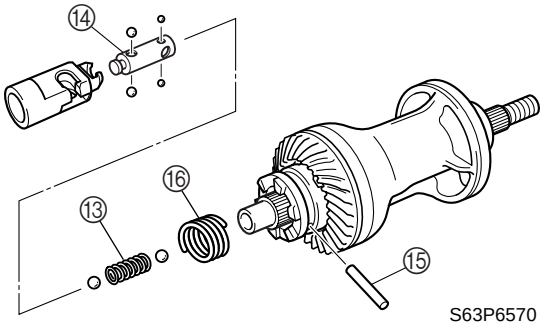


S63P6960

NOTE:
Install the dog clutch ⑫ with the "F" mark ⓔ facing toward the forward gear.

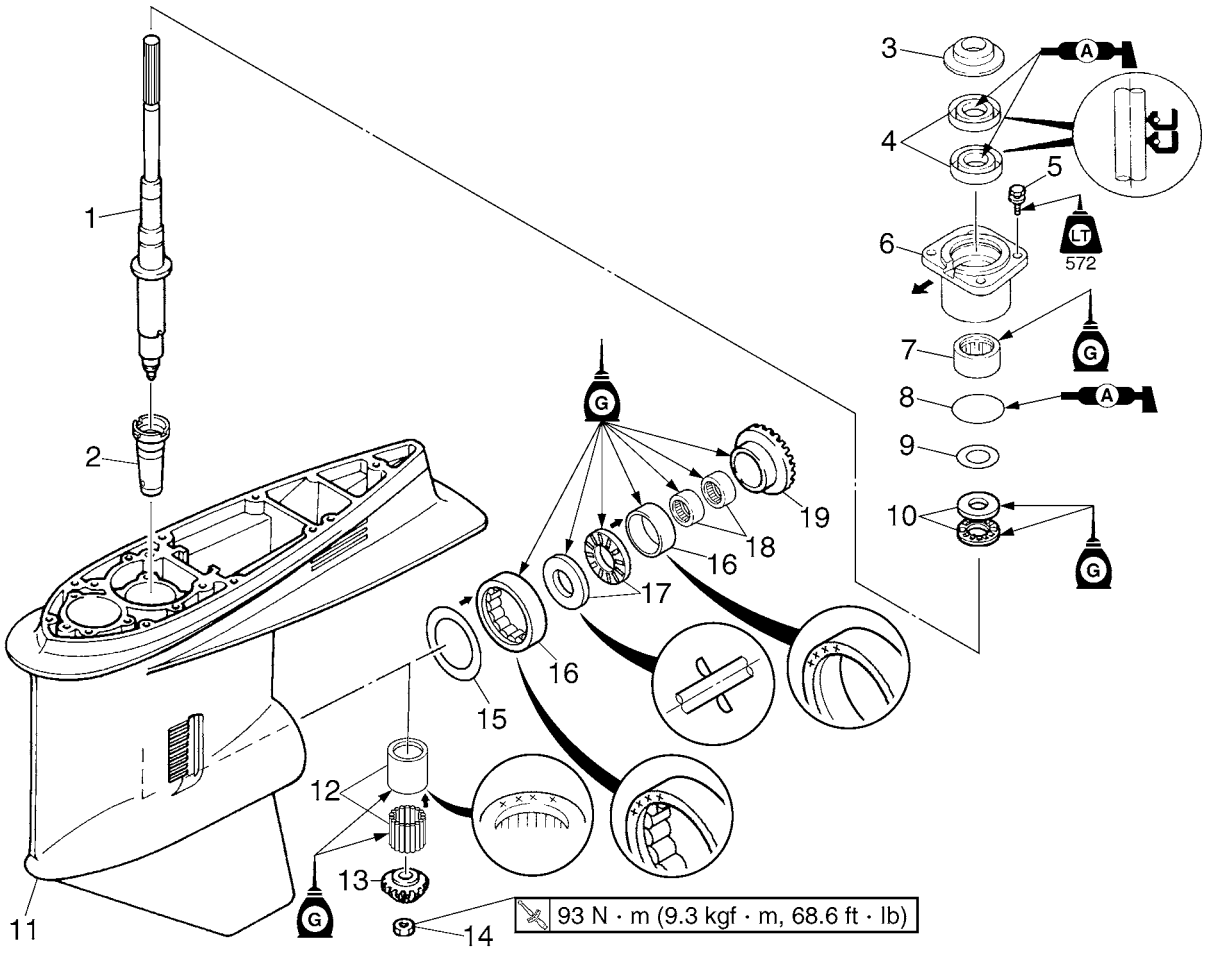
	Ring nut wrench ⑨: 90890-06578

6. Install the spring ⑬, balls, and shift slider ⑭ into the propeller shaft, and then install the cross pin ⑮ and spring ⑯.



S63P6570

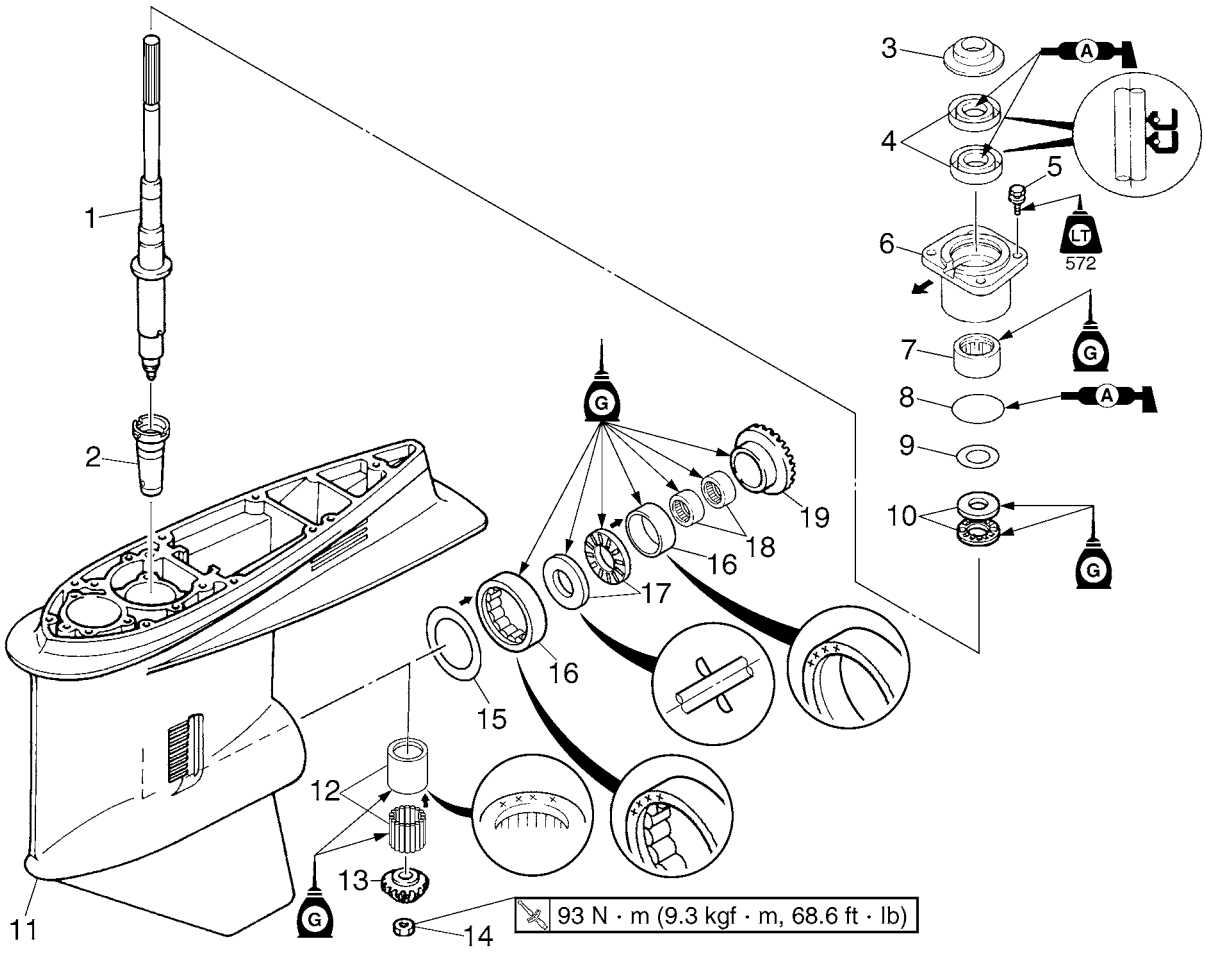
Drive shaft and lower case (counter rotation model)



S63P6580

No.	Part name	Q'ty	Remarks
1	Drive shaft	1	
2	Sleeve	1	
3	Cover	1	
4	Oil seal	2	**Not reusable**
5	Bolt	4	M8 × 25 mm
6	Drive shaft housing	1	
7	Needle bearing	1	
8	O-ring	1	**Not reusable**
9	Pinion shim	—	
10	Thrust bearing	1	
11	Lower case	1	
12	Needle bearing	1	
13	Pinion	1	
14	Nut	1	
15	Reverse gear shim	—	
16	Roller bearing	1	
17	Thrust bearing	1	

6

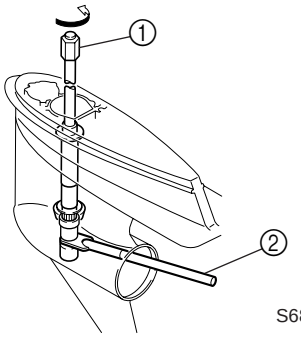


S63P6580

No.	Part name	Q'ty	Remarks
18	Needle bearing	2	**Not reusable**
19	Reverse gear	1	

Removing the drive shaft

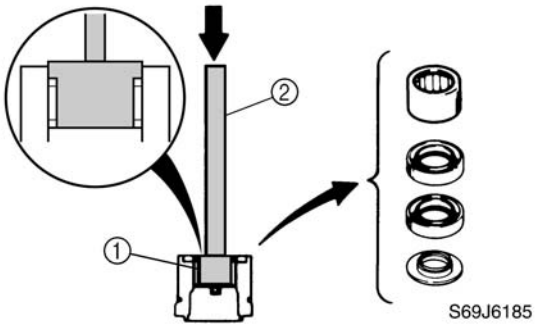
1. Remove the drive shaft assembly and pinion, and then pull out the reverse gear and thrust bearing.



Drive shaft holder 6 ①: 90890-06520
Pinion nut holder ②:
New: 90890-06715
Current: 90890-06505

Disassembling the drive shaft housing

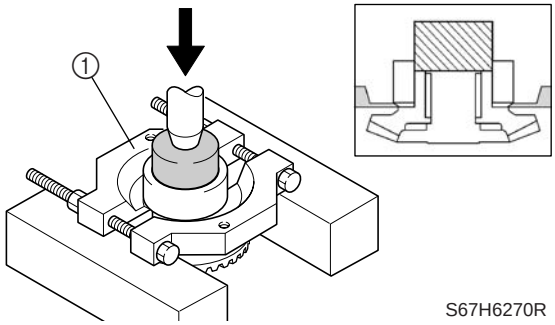
1. Remove the cover, oil seals, and needle bearing.



Needle bearing attachment ①:
90890-06610
Driver rod L3 ②: 90890-06652

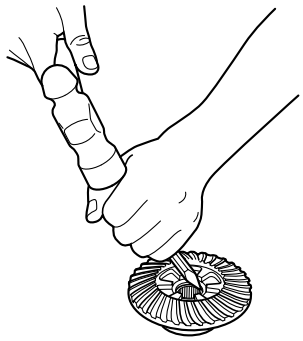
Disassembling the reverse gear

1. Remove the roller bearing inner race from the reverse gear using a press.



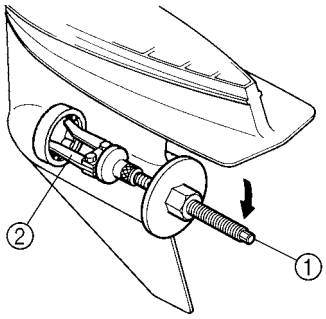
Bearing separator ①: 90890-06534

2. Remove the needle bearings from the reverse gear using a chisel.



Disassembling the lower case

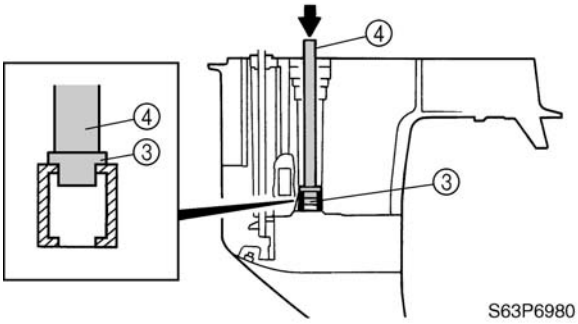
1. Remove the roller bearing and shim(s).



Bearing outer race puller assembly ①:
90890-06523
Outer race puller claw B ②:
90890-06533

6

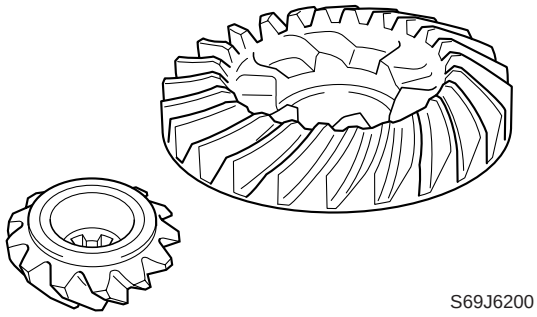
2. Remove the needle bearing from the lower case.



Ball bearing attachment ③: 90890-06636
Driver rod LL ④: 90890-06605

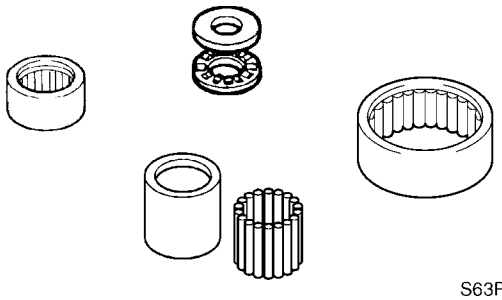
Checking the pinion and reverse gear

1. Check the teeth of the pinion, and the teeth and dogs of the reverse gear for cracks or wear. Replace if necessary.



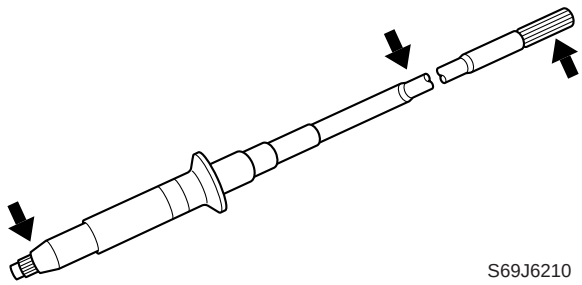
Checking the bearings

1. Check the bearings for pitting or rumbling. Replace if necessary.



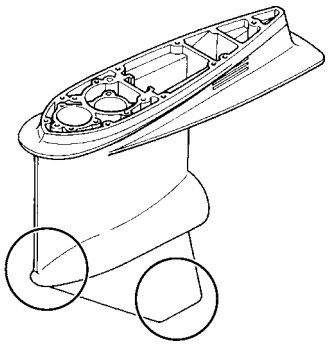
Checking the drive shaft

1. Check the drive shaft for bends or wear. Replace if necessary.



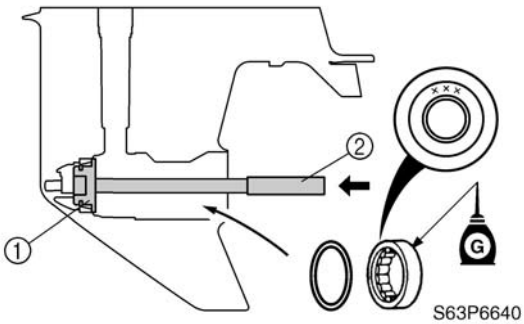
Checking the lower case

1. Check the skeg and torpedo for cracks or damage. Replace the lower case if necessary.



Assembling the lower case

1. Install the original shim(s) and roller bearing into the lower case.

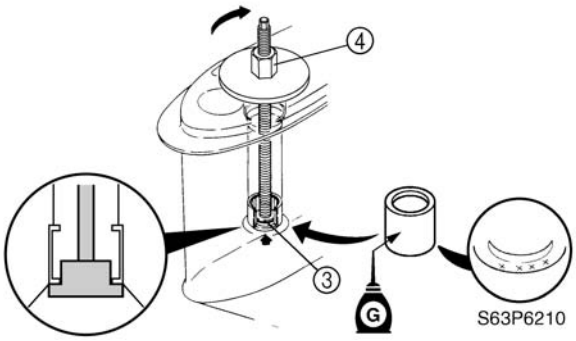


CAUTION:

Add or remove shim(s), if necessary, if replacing the reverse gear roller bearing or lower case.

Ball bearing attachment ①: 90890-06629
Driver rod LL ②: 90890-06605

2. Install the needle bearing outer case into the lower case.



NOTE:
Apply gear oil to the needle bearing outer case before installation.

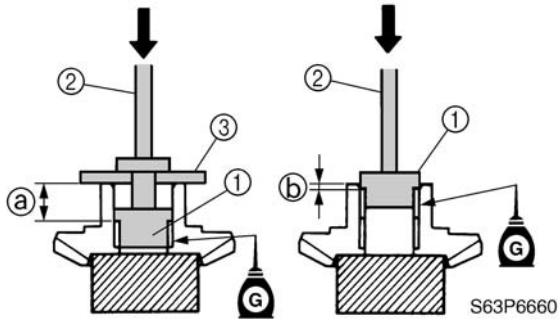
Ball bearing attachment ③:
90890-06633
Bearing outer race puller assembly ④:
90890-06523

3. Install the needle bearing into the needle bearing outer case.

NOTE:
Apply gear oil or grease to the needle bearing before installation.

Assembling the reverse gear

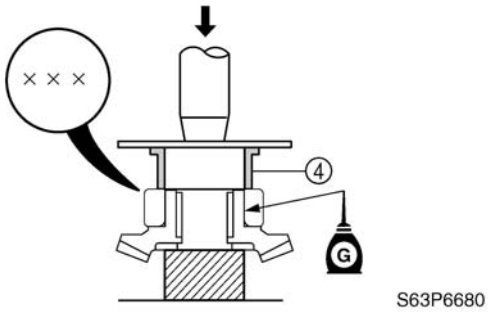
1. Install new needle bearings into the reverse gear to the specified depth.



Needle bearing attachment ①:
90890-06612
Driver rod SS ②: 90890-06604
Bearing depth plate ③: 90890-06603

Depth ⓐ:
20.95–21.45 mm (0.825–0.844 in)
Depth ⓑ:
4.45–4.95 mm (0.175–0.195 in)

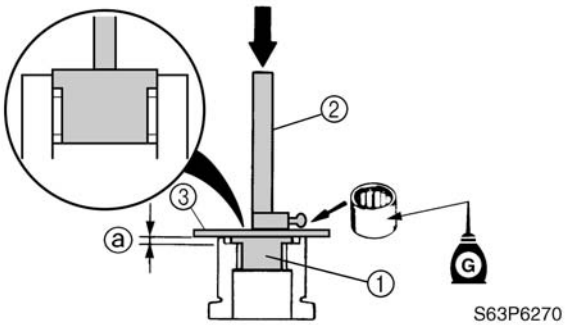
2. Install the roller bearing inner race into the reverse gear using a press.



Bearing inner race attachment ④:
90890-06660

Assembling the drive shaft housing

1. Install the needle bearing into the drive shaft housing to the specified depth.

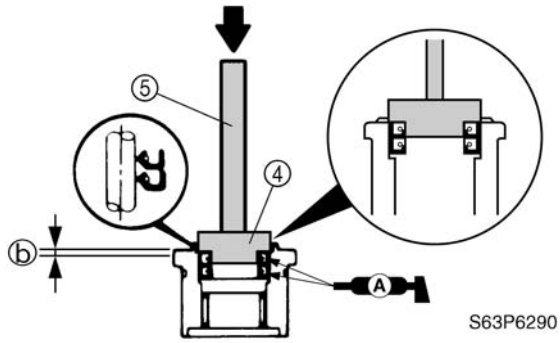


Needle bearing attachment ①:
90890-06610
Driver rod SS ②: 90890-06604
Bearing depth plate ③: 90890-06603

Depth ⓐ:
5.75–6.25 mm (0.226–0.246 in)

6

2. Apply grease to new oil seals, and then install them into the drive shaft housing to the specified depth.



NOTE:
Install an oil seal halfway into the drive shaft housing, then the other oil seal.

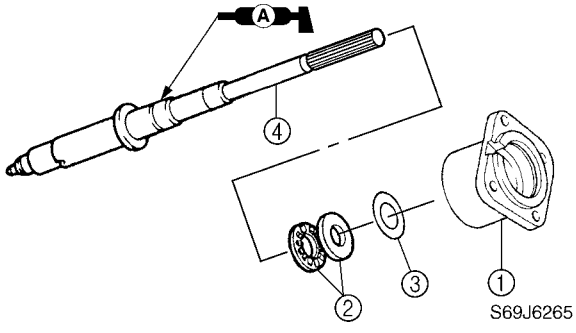
Ball bearing attachment ④:
90890-06633
Driver rod LS ⑤: 90890-06606

Depth ⓑ:
0.25–0.75 mm (0.01–0.03 in)

Installing the drive shaft

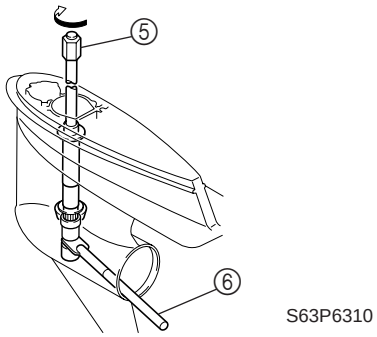
1. Install the reverse gear into the lower case.

2. Install the drive shaft housing ①, thrust bearing ②, and original shim(s) ③ onto the drive shaft ④.



CAUTION:
Add or remove shim(s), if necessary, if replacing the drive shaft housing or drive shaft.

3. Install the sleeve, drive shaft, and drive shaft housing into the lower case, then the pinion and pinion nut, and then tighten the nut to the specified torque.



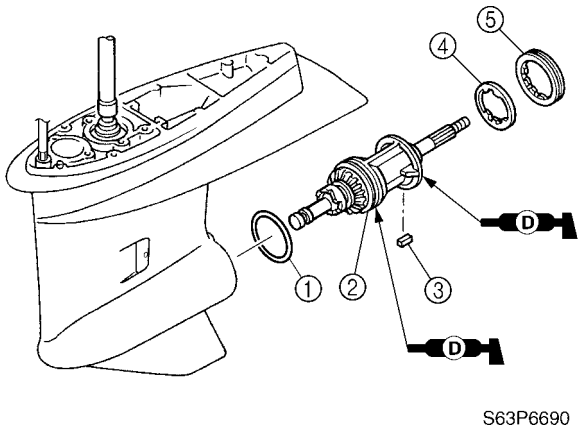
NOTE:
Install the drive shaft by lifting it up slightly, then aligning it with the pinion and the spline of the drive shaft.

Drive shaft holder 6 ⑤: 90890-06520
Pinion nut holder ⑥:
New: 90890-06715
Current: 90890-06505

Pinion nut:
93 N·m (9.3 kgf·m, 68.6 ft·lb)

Installing the propeller shaft housing

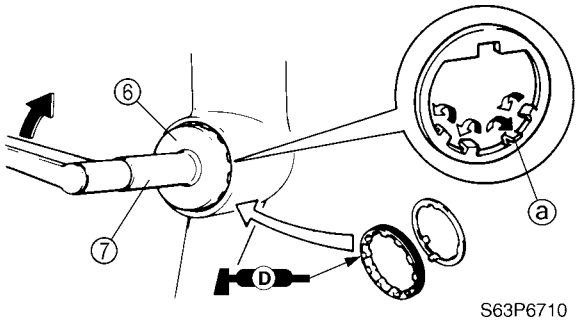
1. Install the original shim(s) ① and propeller shaft housing assembly ② into the lower case, and then install the straight key ③, claw washer ④, and ring nut ⑤.



CAUTION:

Add or remove shim(s), if necessary, if replacing the forward gear, taper roller bearing, propeller shaft housing, thrust washer, or lower case.

2. Tighten the ring nut to the specified torque.



S63P6710

NOTE:

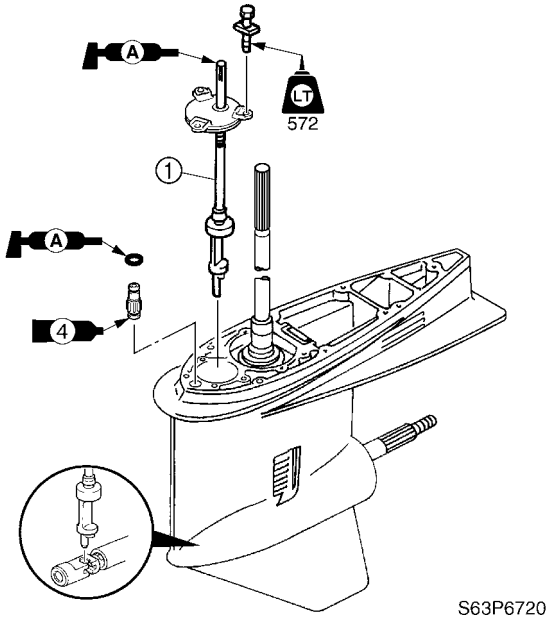
- To secure the ring nut, bend one tab ⓐ of the claw washer into a slot in the ring nut.
- Bend all other tabs toward the propeller shaft housing assembly.

	Ring nut wrench 4 ⑥: 90890-06512 Ring nut wrench extension ⑦: 90890-06513

	Ring nut ⑤: 142 N·m (14.2 kgf·m, 104.7 ft·lb)

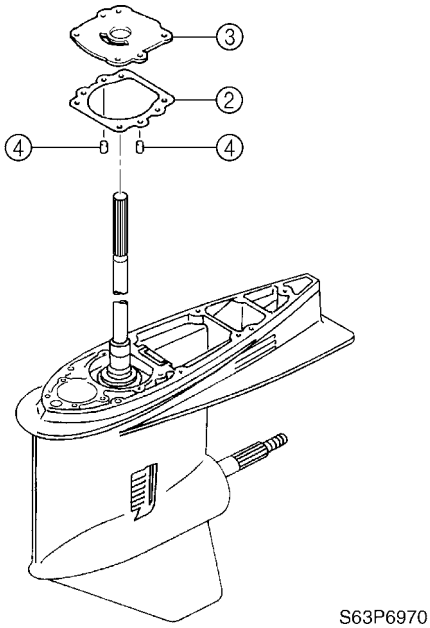
Installing the water pump and shift rod

1. Install the shift rod assembly ①.



S63P6720

2. Install a new gasket ②, the outer plate cartridge ③, and dowels ④.

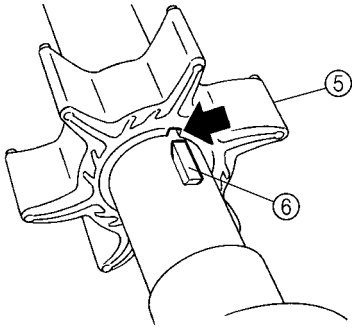


S63P6970

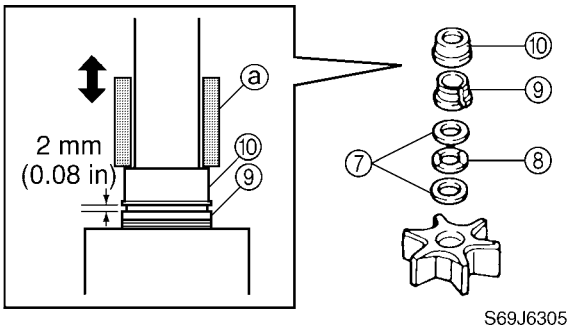
6

3. Install the Woodruff key into the drive shaft.

4. Align the groove in the impeller ⑤ with the Woodruff key ⑥, and then install the impeller onto the drive shaft.

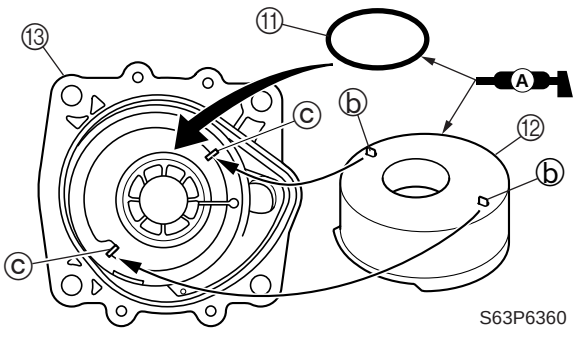


5. Install the washers ⑦, wave washer ⑧, spacer ⑨, and collar ⑩ onto the drive shaft.



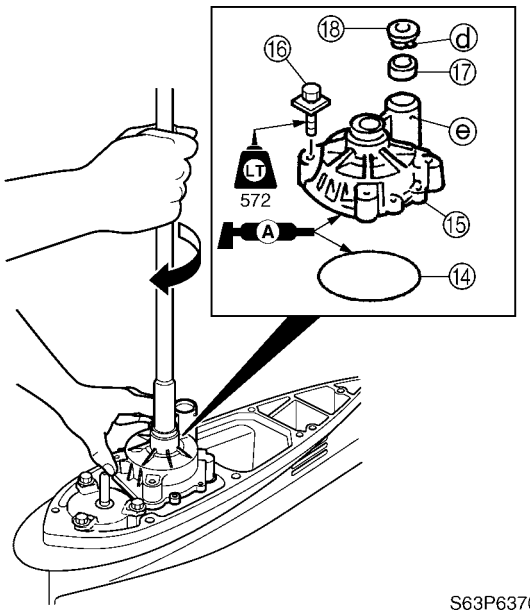
NOTE:
- The collar and spacer should fit together firmly.
- While pulling the drive shaft up, install the collar with an appropriate tool ⓐ that fits over the drive shaft as shown.

6. Install the new O-ring ⑪ and insert cartridge ⑫ into the pump housing ⑬.



NOTE:
Align the insert cartridge projections ⓑ with the holes ⓒ in the pump housing.

7. Install the new O-ring ⑭ and pump housing assembly ⑮ into the lower case, tighten the bolts ⑯, and then install the seal ⑰ and cover ⑱.

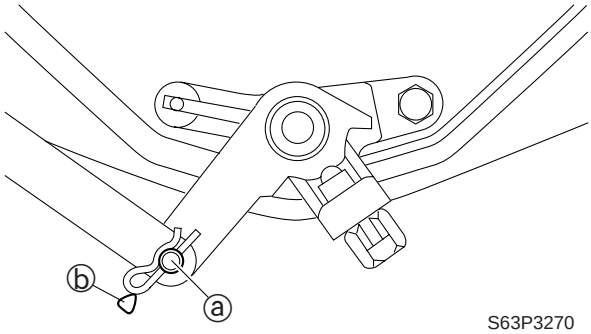


NOTE:
- When installing the pump housing, apply grease to the inside of the housing, and then turn the drive shaft clockwise while pushing down the pump housing.
- Align the cover projection ⓓ with the hole ⓔ in the pump housing.

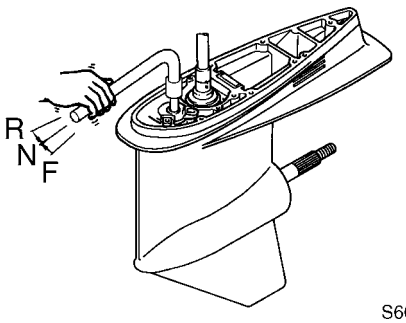
Installing the lower unit

1. Set the gear shift to the neutral position at the lower unit.

2. Align the center of the set pin ⓐ with the mark ⓑ on the bottom cowling.



S63P3270



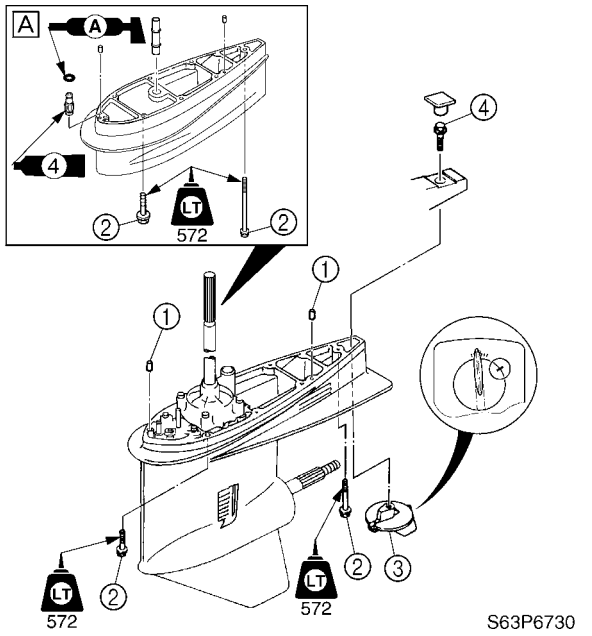
S60V6330

Shift rod push arm: 90890-06052

3. Install the two dowels ① into the lower unit.

4. Install the lower unit into the upper case, and then tighten the lower case mounting bolts ② to the specified torque.

5. Install the trim tab ③ to its original position, and then tighten the bolt ④ to the specified torque.



S63P6730

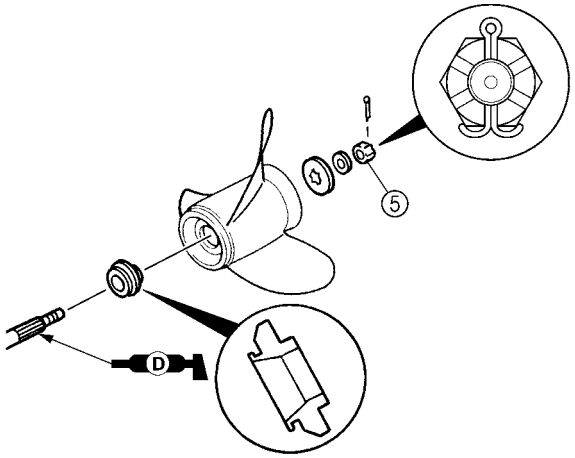
A X-transom model

Lower case mounting bolt ②:
47 N·m (4.7 kgf·m, 34.7 ft·lb)
Trim tab bolt ④:
42 N·m (4.2 kgf·m, 31.0 ft·lb)

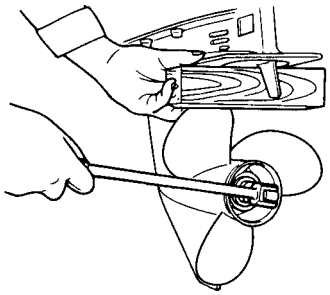
6

6. Install the propeller and propeller nut, and then tighten the nut finger tight. Place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then tighten the nut to the specified torque.

	Propeller nut ⑤: 52 N·m (5.2 kgf·m, 38.4 ft·lb)



S60V6660



S69J6540

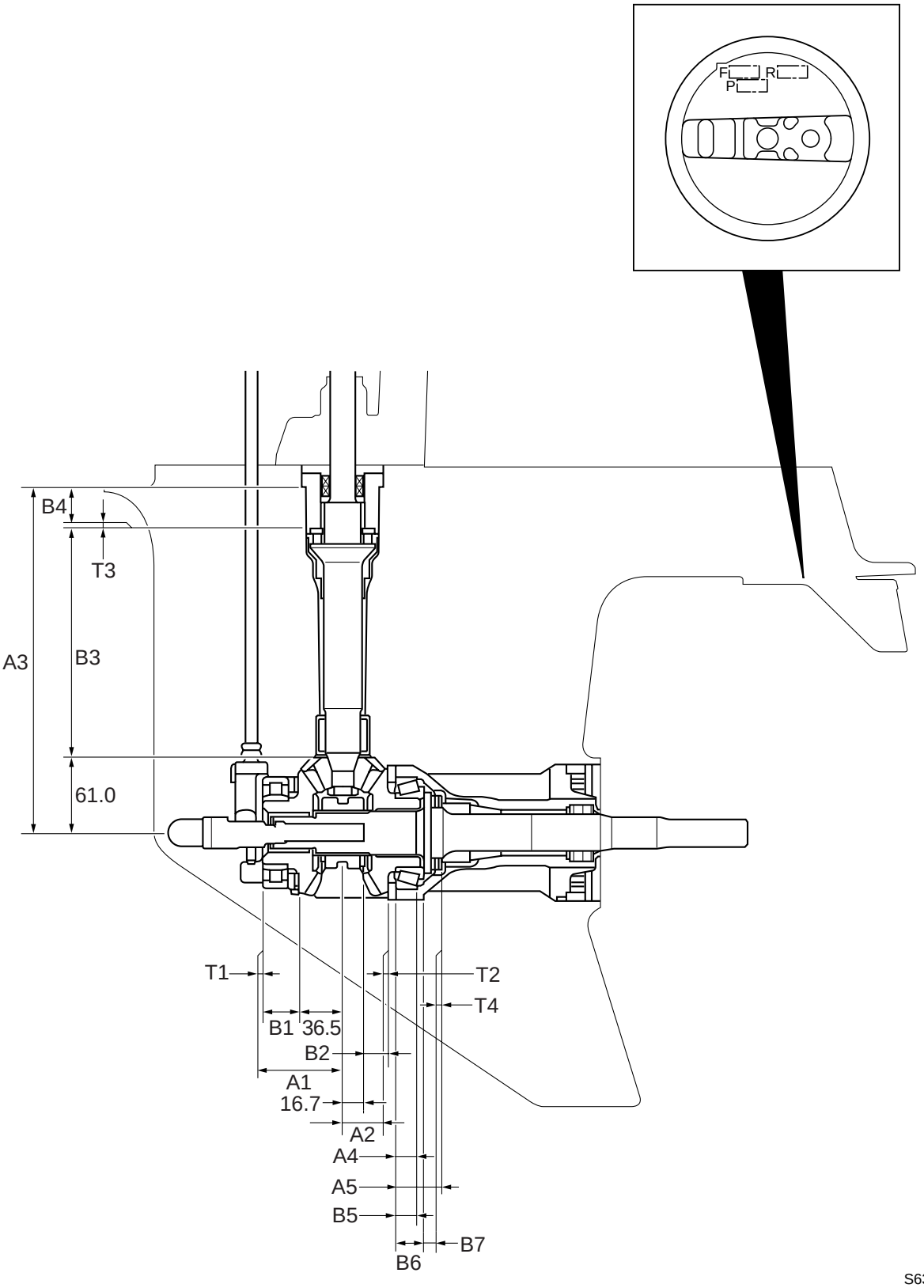
⚠ WARNING

- **Do not hold the propeller with your hands when loosening or tightening it.**
- **Be sure to disconnect the battery leads from the battery and the engine stop lanyard from the engine stop lanyard switch.**
- **Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**

NOTE:

If the grooves in the propeller nut ⑤ do not align with the cotter pin hole, tighten the nut until they are aligned.

Shimming (counter rotation model)



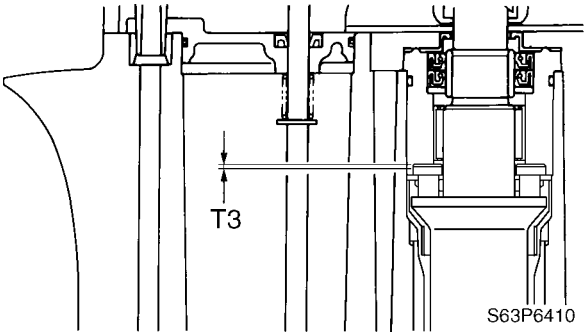
S63P6740

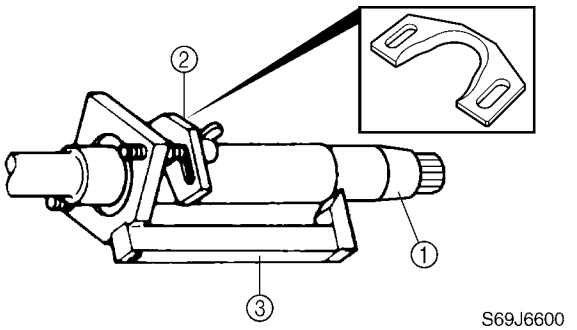
Shimming

NOTE:
- Shimming is not required when assembling the original lower case and inner parts.
- Shimming is required when assembling the original inner parts and a new lower case.
- Shimming is required when replacing the inner part(s).

Selecting the pinion shims

1. Install the special service tools onto the drive shaft ①.





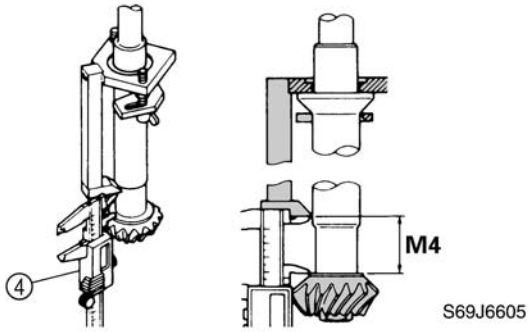
NOTE:
- Select the shim thickness (T3) by using the specified measurement(s) and the calculation formula.
- Install the special service tool onto the drive shaft so that the shaft is at the center of the hole.
- Tighten the wing nuts another 1/4 of a turn after they contact the fixing plate ②.

Pinion height gauge ③:
90890-06710

2. Install the pinion and pinion nut, and then tighten the nut to the specified torque.

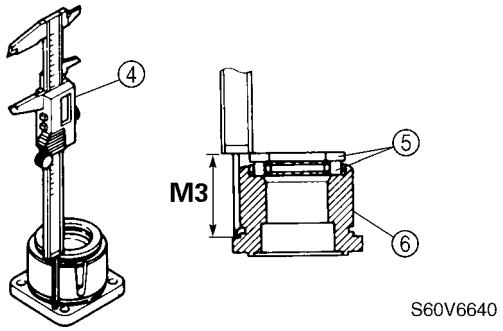
Pinion nut:
93 N·m (9.3 kgf·m, 68.6 ft·lb)

3. Measure the distance (M4) between the special service tool and the pinion as shown.



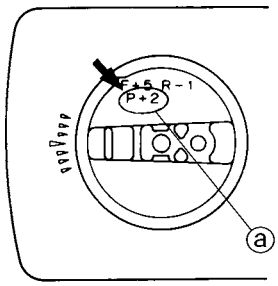
Digital caliper ④: 90890-06704

4. Turn the thrust bearing ⑤ two or three times to seat the drive shaft housing ⑥, and then measure the housing height (M3) as shown.



NOTE:
Measure the thrust bearing at three points to find the height average.

5. Calculate the pinion shim thickness (T3) as shown in the examples below.



S69J6555

NOTE:
"P" is the deviation of the lower case dimension from standard. The "P" mark ⓐ is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "P" mark is unreadable, assume that "P" is zero and check the backlash when the unit is assembled.

Calculation formula:
Pinion shim thickness (T3) =
80.00 + P/100 – M3 – M4

Example:
If "M3" is 46.68 mm and "M4" is 32.49 mm and "P" is (–5), then
T3 = 80.00 + (–5)/100 – 46.68 – 32.49 mm
= 80.00 – 0.05 – 46.68 – 32.49 mm
= 0.78 mm

6. Select the pinion shim(s) (T3) as follows.

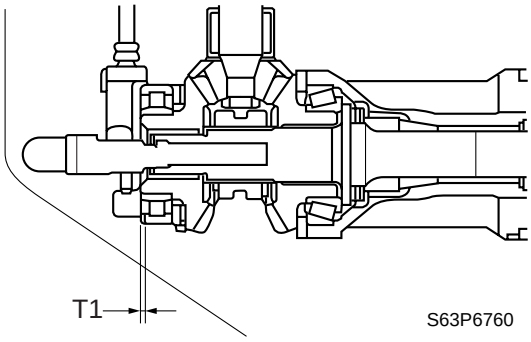
Calculated numeral at 1/100 place	Rounded numeral
1, 2	0
3, 4, 5	2
6, 7, 8	5
9, 10	8

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

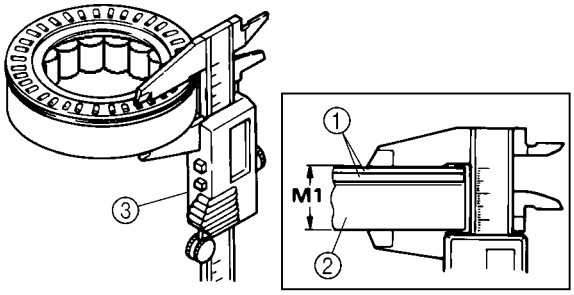
Example:
If "T3" is 0.53 mm, then the pinion shim is 0.52 mm.
If "T3" is 0.78 mm, then the pinion shim is 0.75 mm.

Selecting the reverse gear shims

1. Turn the thrust bearing ① two or three times to seat the roller bearing ②, and then measure the bearing height (M1) as shown.



S63P6760



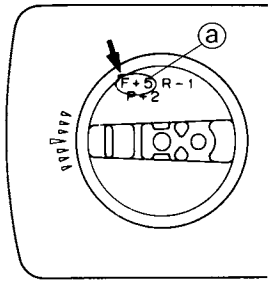
S63P6880

NOTE:
- Select the shim thickness (T1) by using the specified measurement(s) and the calculation formula.
- Measure the roller bearing at three points to find the height average.

Digital caliper ③: 90890-06704

6

2. Calculate the reverse gear shim thickness (T1) as shown in the examples below.



S69J6570

NOTE:
"F" is the deviation of the lower case dimension from standard. The "F" mark ⓐ is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "F" mark is unreadable, assume that "F" is zero and check the backlash when the unit is assembled.

Calculation formula:
Reverse gear shim thickness (T1) =
29.10 + F/100 – M1

Example:
If "M1" is 28.25 mm and "F" is (+5), then
T1 = 29.10 + (+5)/100 – 28.25 mm
= 29.10 + 0.05 – 28.25 mm
= 0.90 mm

3. Select the reverse gear shim(s) (T1) as follows.

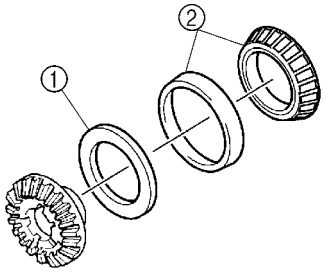
Calculated numeral at 1/100 place	Rounded numeral
1, 2	0
3, 4, 5	2
6, 7, 8	5
9, 10	8

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

Example:
If "T1" is 0.90 mm, then the reverse gear shim is 0.88 mm.
If "T1" is 1.15 mm, then the reverse gear shim is 1.12 mm.

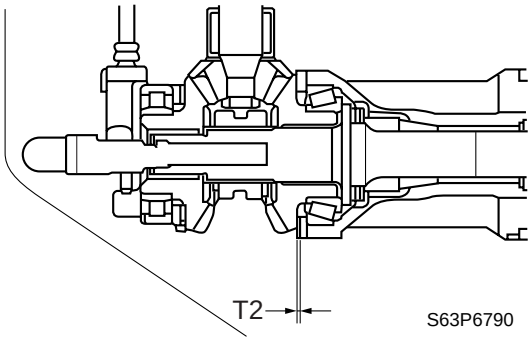
Selecting the forward gear shims

1. Install the thrust washer ① and taper roller bearing ② onto the forward gear.

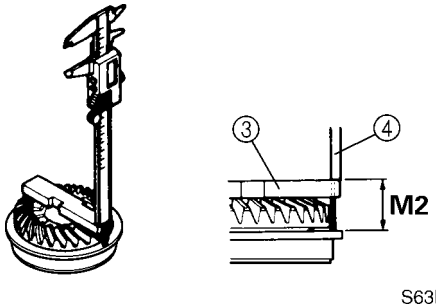


S63P6770

2. Measure the gear height (M2) from the thrust washer on the taper roller bearing.



S63P6790

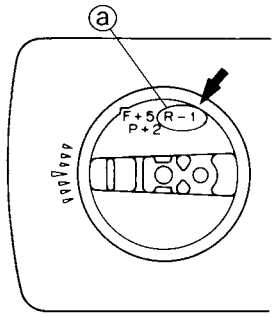


S63P6890

NOTE:
- Select the shim thickness (T2) by using the specified measurement(s) and the calculation formula.
- Measure the forward gear at three points to find the height average.

Shimming plate ③: 90890-06701
Digital caliper ④: 90890-06704

3. Calculate the forward gear shim thickness (T2) as shown in the examples below.



S69J6585

NOTE:
"R" is the deviation of the lower case dimension from standard. The "R" mark ⓐ is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "R" mark is unreadable, assume that "R" is zero and check the backlash when the unit is assembled.

Calculation formula:
Forward gear shim thickness (T2) =
M2 – 29.50 – R/100

Example:
If "M2" is 29.84 mm and "R" is (+1), then
T2 = 29.84 – 29.50 – (+1)/100 mm
= 29.84 – 29.50 – 0.01 mm
= 0.33 mm

4. Select the forward gear shim(s) (T2) as follows.

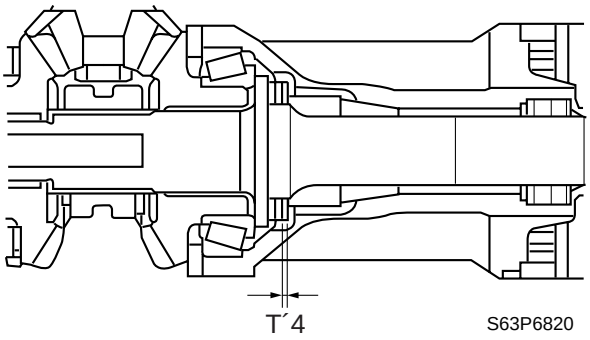
Calculated numeral at 1/100 place	Rounded numeral
1, 2	2
3, 4, 5	5
6, 7, 8	8
9, 10	10

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

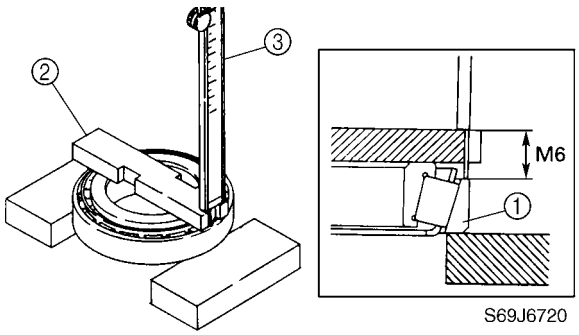
Example:
If "T2" is 0.33 mm, then the forward gear shim is 0.35 mm.
If "T2" is 0.79 mm, then the forward gear shim is 0.80 mm.

Selecting the propeller shaft shims

1. Turn the taper roller bearing outer race ① two or three times to seat the rollers, and then measure the bearing height (M6) as shown.



S63P6820

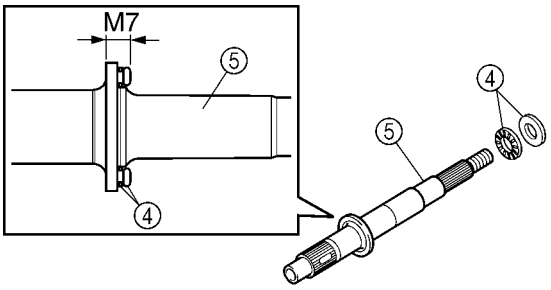


S69J6720

NOTE:
- Select the shim thickness (T'4) by using the specified measurement(s) and the calculation formula.
- Measure the taper roller bearing at three points to find the height average.

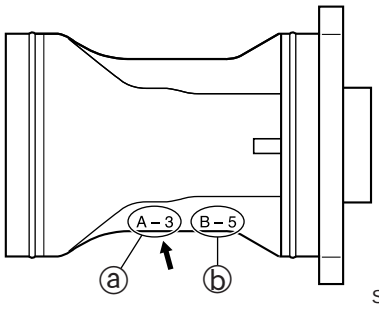
Shimming plate ②: 90890-06701
Digital caliper ③: 90890-06704

2. Install the thrust bearing ④ onto the propeller shaft ⑤, and then measure the propeller shaft flange and thrust bearing thickness (M7) as shown.



S69J6696

3. Calculate the propeller shaft shim thickness (T4) as shown in the examples below.



S69J6626

NOTE:
"A" and "B" are the deviation of the propeller shaft housing dimension from standard. The "A" mark ⓐ and "B" mark ⓑ are stamped on the propeller shaft housing in 0.01 mm units. If the "A" mark or "B" mark is unreadable, assume that "A" and "B" are zero and check the free play when the unit is assembled.

Calculation formula 1:
Propeller shaft shim thickness (T4) =
29.30 – A/100 + B/100 – M6 – M7

Example:
If "M6" is 15.70 mm and "M7" is 12.55 mm and "A" is (+6) and "B" is (–5), then
T4 = 29.30 – (+6)/100 + (–5)/100 – 15.70 – 12.55 mm
= 29.30 – 0.06 – 0.05 – 15.70 – 12.55 mm
= 0.94 mm

4. Round the numerals for the propeller shaft shim(s) (T4) as follows.

Calculated numeral at 1/100 place	Rounded numeral
1, 2	0
3, 4, 5	2
6, 7, 8	5
9, 10	8

Example:
If "T4" is 0.94 mm, then the propeller shaft shim is 0.92 mm.
If "T4" is 1.00 mm, then the propeller shaft shim is 0.98 mm.

5. Calculate and select the propeller shaft shim thickness (T'4) as shown in the examples below.

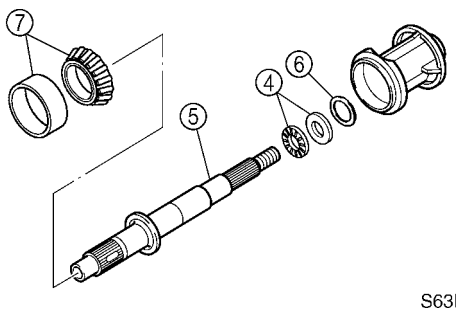
Calculation formula 2:
Propeller shaft shim thickness (T'4) =
T4 – 0.30

Example:
If "T4" is 0.92 mm, then
T'4 = 0.92 – 0.30 mm
= 0.62 mm

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

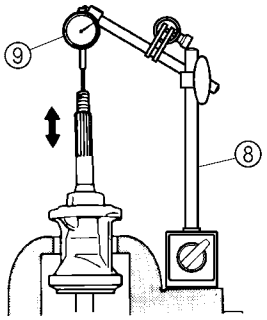
6. If the "A" mark or "B" mark is unreadable, measure the propeller shaft free play as shown.

7. Install the shim(s) ⑥, thrust bearing ④, propeller shaft ⑤, and taper roller bearing ⑦ into the propeller shaft housing.



S63P6900

8. Measure the propeller shaft free play. Repeat steps 1–7 if out of specification.



S63P6910

Propeller shaft free play:
0.25–0.35 mm (0.0098–0.0138 in)

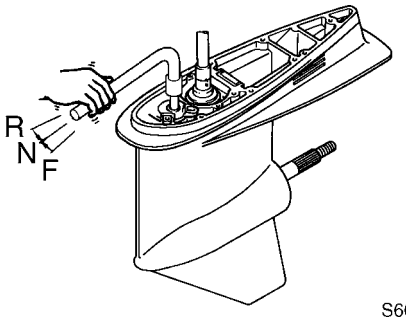
Magnet base B ⑧: 90890-06844
Dial gauge set ⑨: 90890-01252

Backlash (counter rotation model)

Measuring the forward and reverse gear backlash

1. Remove the water pump assembly.

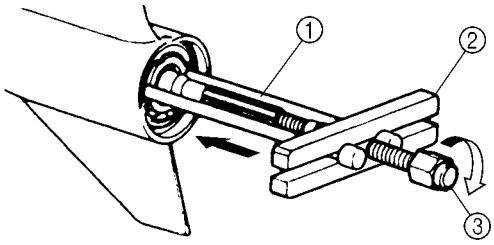
2. Set the gear shift to the neutral position at the lower unit.



S60V6330

Shift rod push arm: 90890-06052

3. Install the special service tools so that it pushes against the propeller shaft.



S60X6370

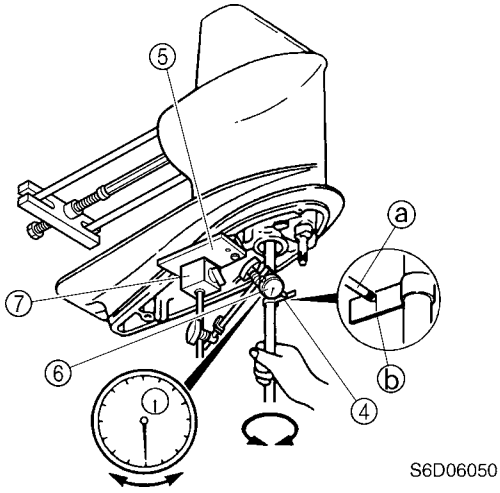
NOTE:
Tighten the center bolt while turning the drive shaft until the drive shaft can no longer be turned.

Bearing housing puller claw L ①: 90890-06502
Stopper guide plate ②: 90890-06501
Center bolt ③: 90890-06504

4. Install the backlash indicator onto the drive shaft (22.4 mm [0.88 in] in diameter), then the dial gauge onto the lower unit.

6

5. Set the lower unit upside down.



NOTE:
Install the dial gauge so that the plunger ⓐ contacts the mark ⓑ on the backlash indicator.

Backlash indicator ④: 90890-06706
Magnet base plate ⑤: 90890-07003
Dial gauge set ⑥: 90890-01252
Magnet base B ⑦: 90890-06844

6. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.

Forward gear backlash:
0.14–0.42 mm (0.0055–0.0165 in)

7. Add or remove shim(s) if out of specification.

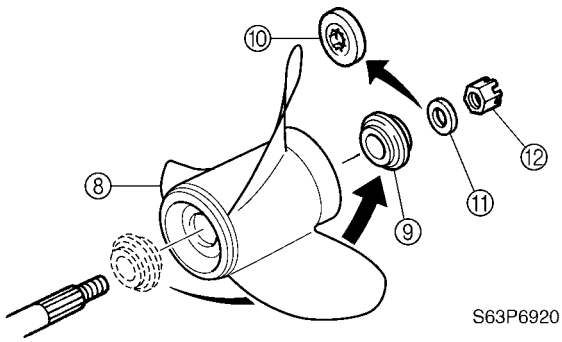
Forward gear backlash	Shim thickness
Less than 0.14 mm (0.0055 in)	To be increased by (0.28 – M) × 0.67
More than 0.42 mm (0.0165 in)	To be decreased by (M – 0.28) × 0.67

M: Measurement

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

8. Remove the special service tools from the propeller shaft.

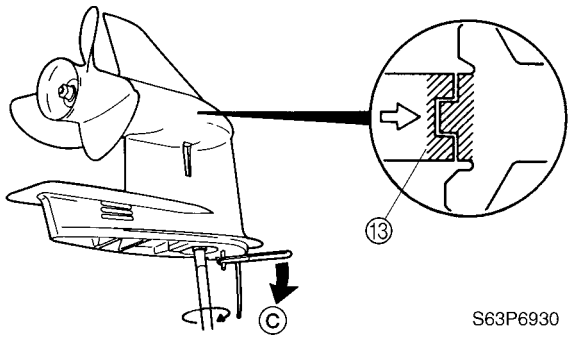
9. Install the propeller ⑧, the spacer ⑨ (without the washer ⑩), then the washer ⑪ as shown.



NOTE:
Tighten the propeller nut ⑫ while turning the propeller until the propeller can no longer be turned.

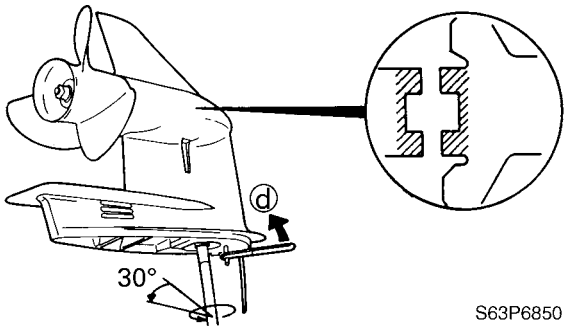
10. Turn the shift rod to the reverse position ⓒ with the shift rod push arm.

11. Turn the drive shaft clockwise until the dog clutch ⑬ is fully engaged.



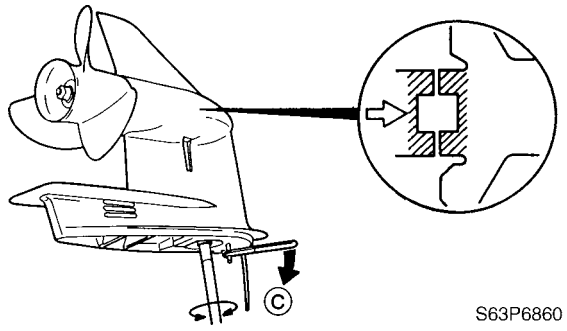
12. Turn the shift rod to the neutral position ⓓ with the shift rod push arm.

13. Turn the drive shaft counterclockwise approximately 30°.



14. Turn the shift rod to the reverse position Ⓒ with the shift rod push arm.

15. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.



NOTE:
When measuring the reverse gear backlash, turn the shift rod push arm towards the reverse position Ⓒ with force.

Reverse gear backlash:
0.23–0.58 mm (0.0090–0.0228 in)

16. Add or remove shim(s) if out of specification.

Reverse gear backlash	Shim thickness
Less than 0.23 mm (0.0090 in)	To be decreased by (0.41 – M) × 0.67
More than 0.58 mm (0.0228 in)	To be increased by (M – 0.41) × 0.67

M: Measurement

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

17. Remove the special service tools, and then install the water pump assembly.

— MEMO —

Bracket unit

Special service tools 7-1

Bottom cowling 7-2

Upper case, steering arm, swivel bracket and clamp brackets 7-6
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Removing the clamp brackets 7-18
Installing the clamp brackets 7-18
Adjusting the trim sensor cam 7-18

Power trim and tilt unit 7-20
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Assembling the gear pump housing 7-35
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Assembling the tilt piston and trim pistons 7-39
Assembling the power trim and tilt unit 7-40
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Checking the fuse 7-47
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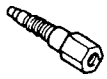
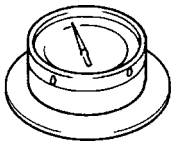
Checking the power trim and tilt switch 7-47
Checking the trim sensor 7-48

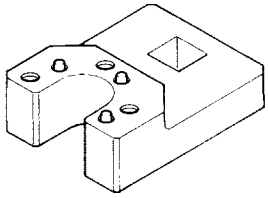
Special service tools



Up relief fitting
90890-06773
Down relief fitting
90890-06774

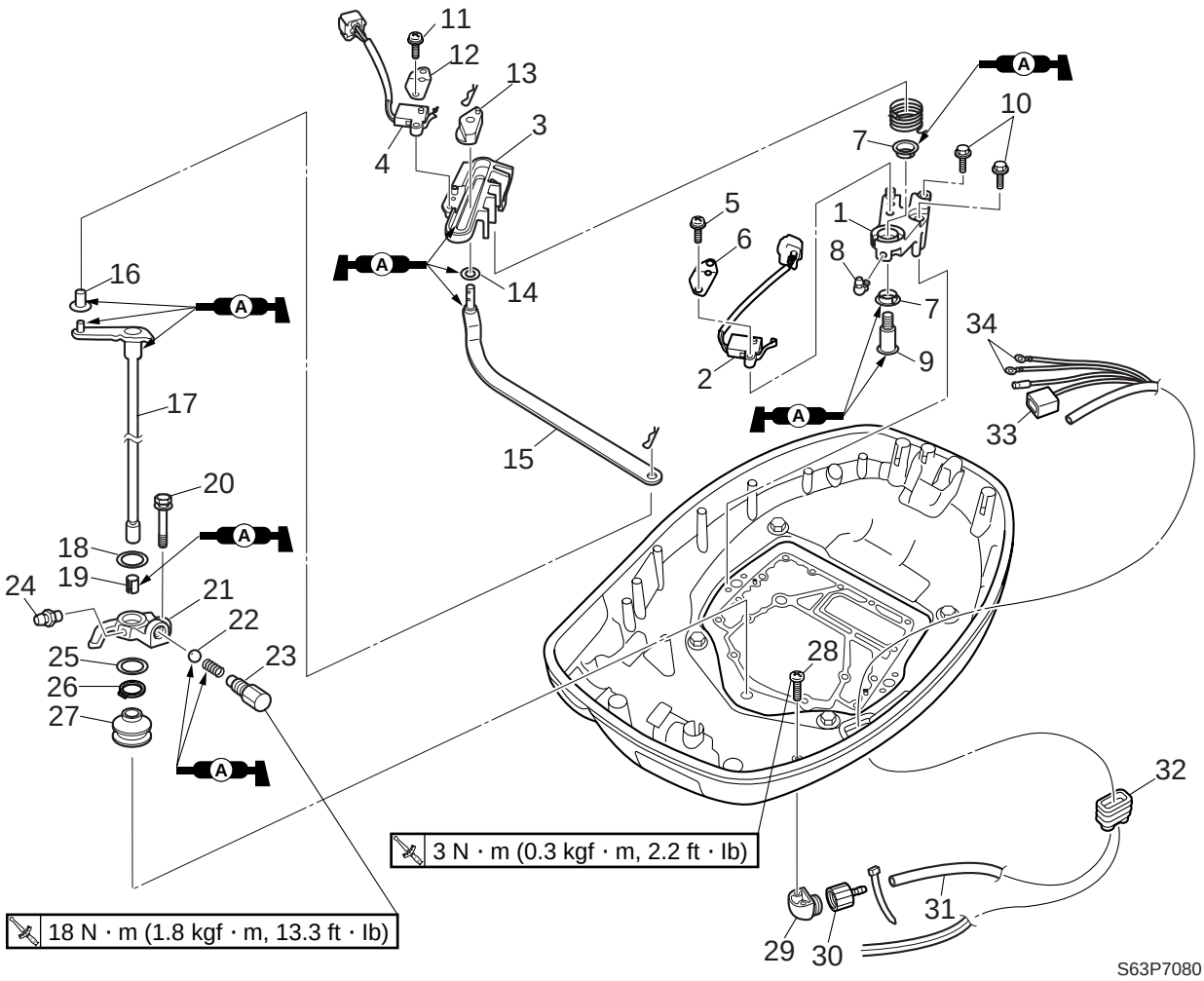


Hydraulic pressure gauge
90890-06776



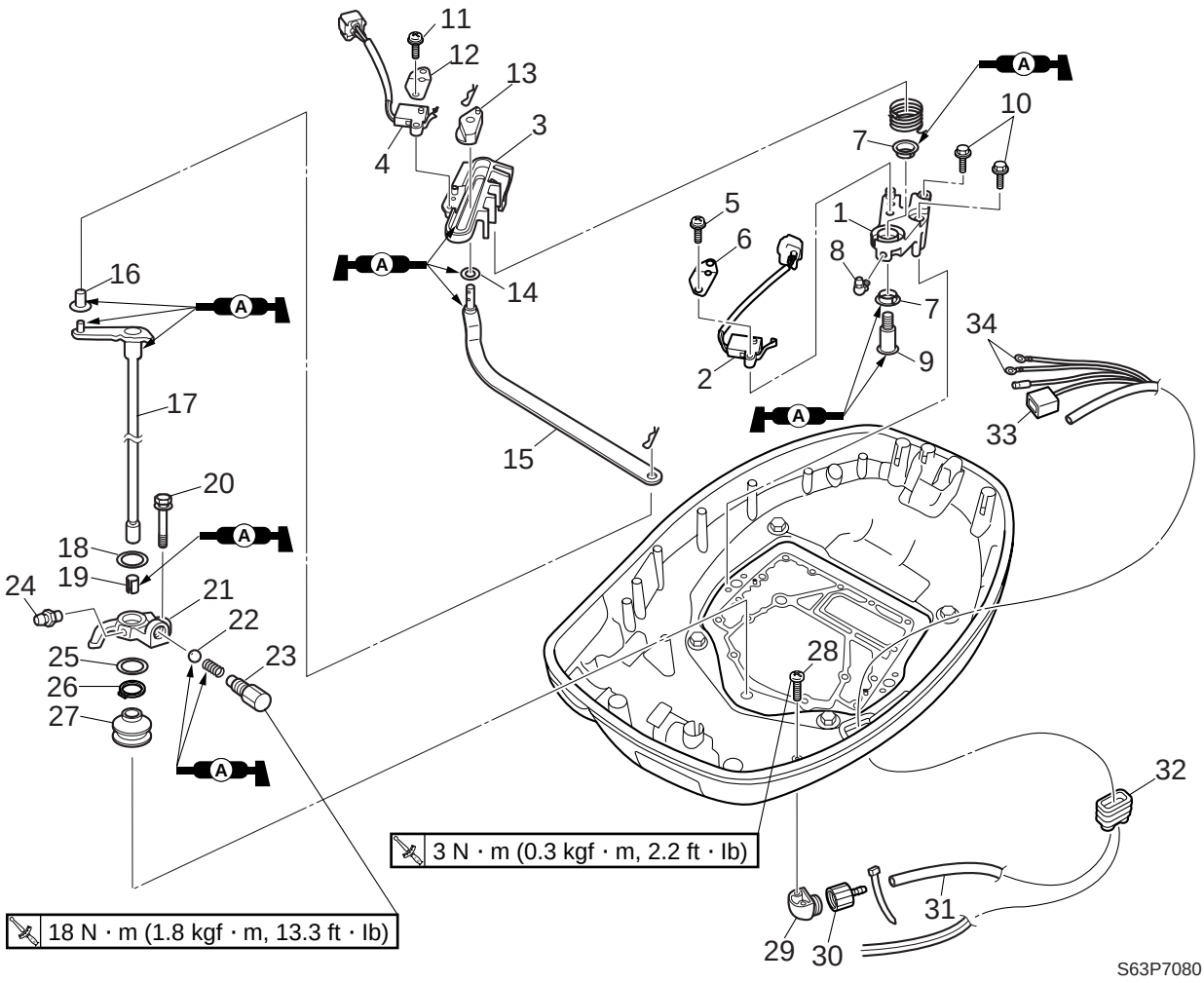
Trim and tilt wrench
New: 90890-06587
Current: 90890-06548

Bottom cowling

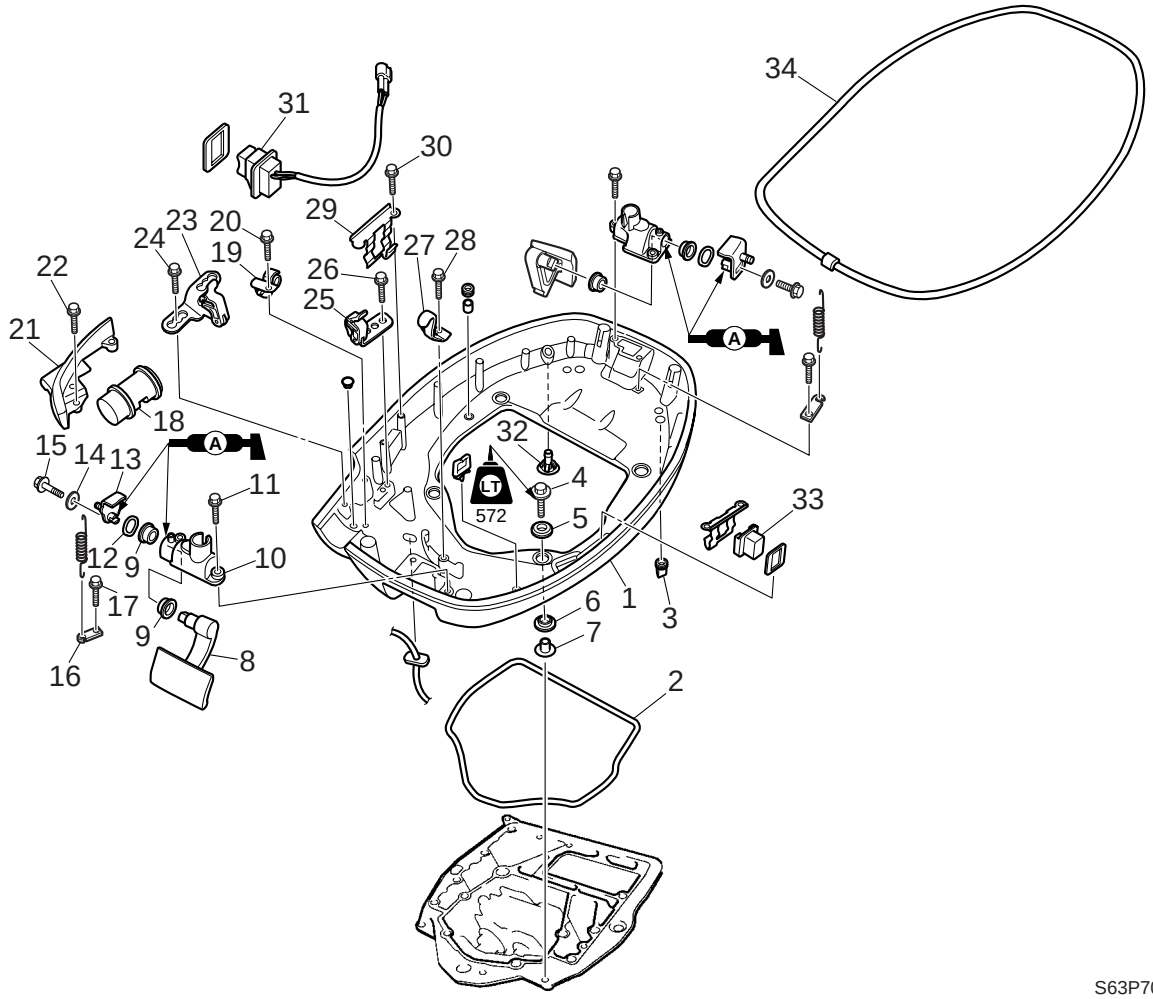


No.	Part name	Q'ty	Remarks
1	Bracket	1	
2	Shift cut switch	1	
3	Bracket	1	
4	Neutral switch	1	
5	Screw	2	ø4 × 16 mm
6	Plate	1	
7	Bushing	2	
8	Grease nipple	1	
9	Bolt	1	
10	Bolt	2	M6 × 50 mm
11	Screw	2	ø4 × 16 mm
12	Plate	1	
13	Bushing	1	
14	Washer	1	
15	Shift lever	1	
16	Bushing	1	
17	Shift rod	1	

7



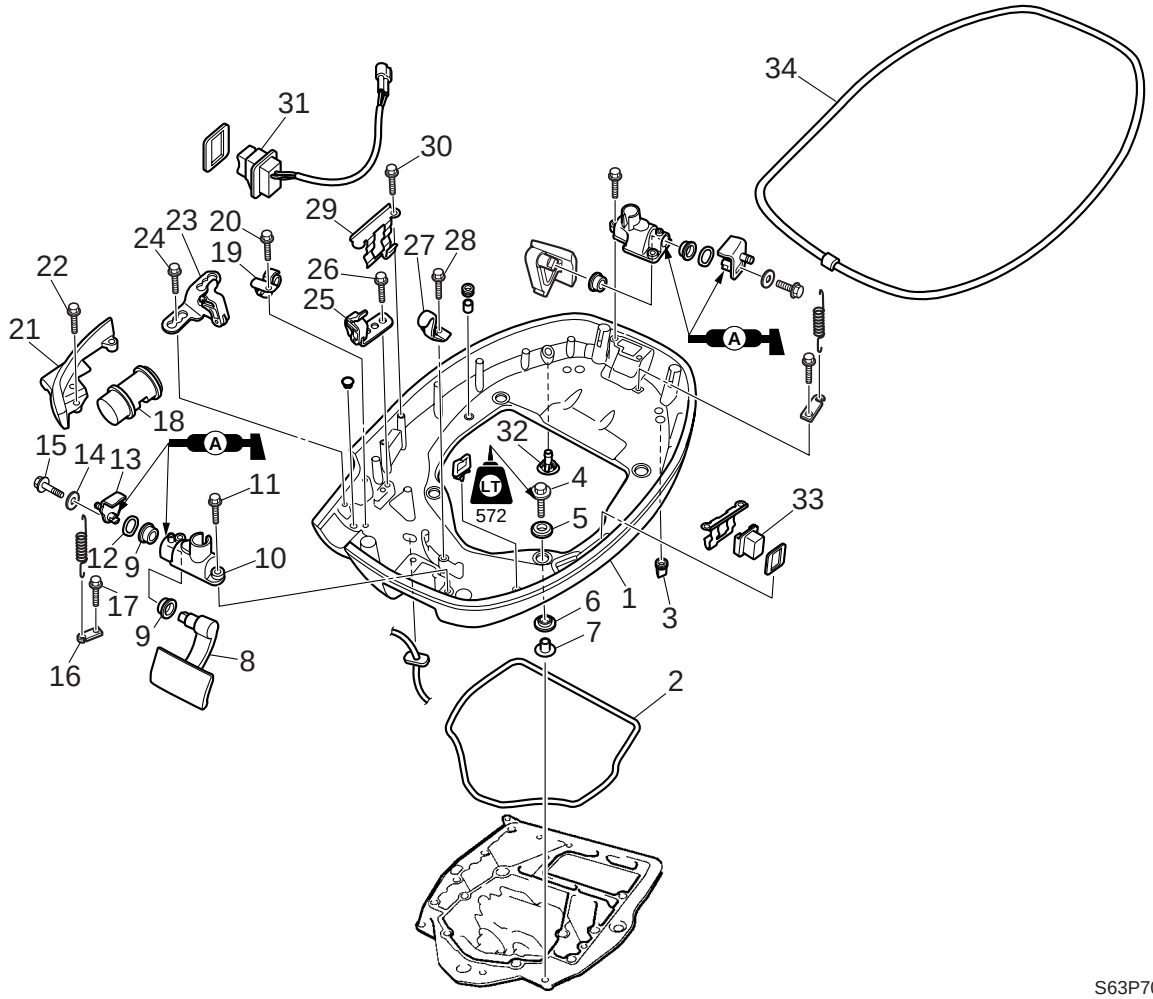
No.	Part name	Q'ty	Remarks
18	Spacer	1	
19	Bushing	1	
20	Bolt	1	M6 × 35 mm
21	Bracket	1	
22	Ball	1	
23	Bolt	1	
24	Grease nipple	1	
25	Spacer	1	
26	Circlip	1	
27	Grommet	1	
28	Screw	2	ø6 × 20 mm
29	Adapter	1	
30	Hose joint	1	
31	Flushing hose	1	
32	Grommet	1	
33	Trim sensor coupler	1	
34	PTT motor lead	1	



S63P7070

No.	Part name	Q'ty	Remarks
1	Bottom cowling	1	
2	Rubber seal	1	
3	Grommet	2	
4	Bolt	4	M8 × 35 mm
5	Grommet	4	
6	Grommet	4	
7	Collar	4	
8	Cowling lock lever	2	
9	Bushing	4	
10	Plate	2	
11	Bolt	4	M6 × 30 mm
12	Wave washer	2	
13	Lever	2	
14	Washer	2	
15	Bolt	2	M6 × 20 mm
16	Stay	2	
17	Bolt	2	M6 × 20 mm

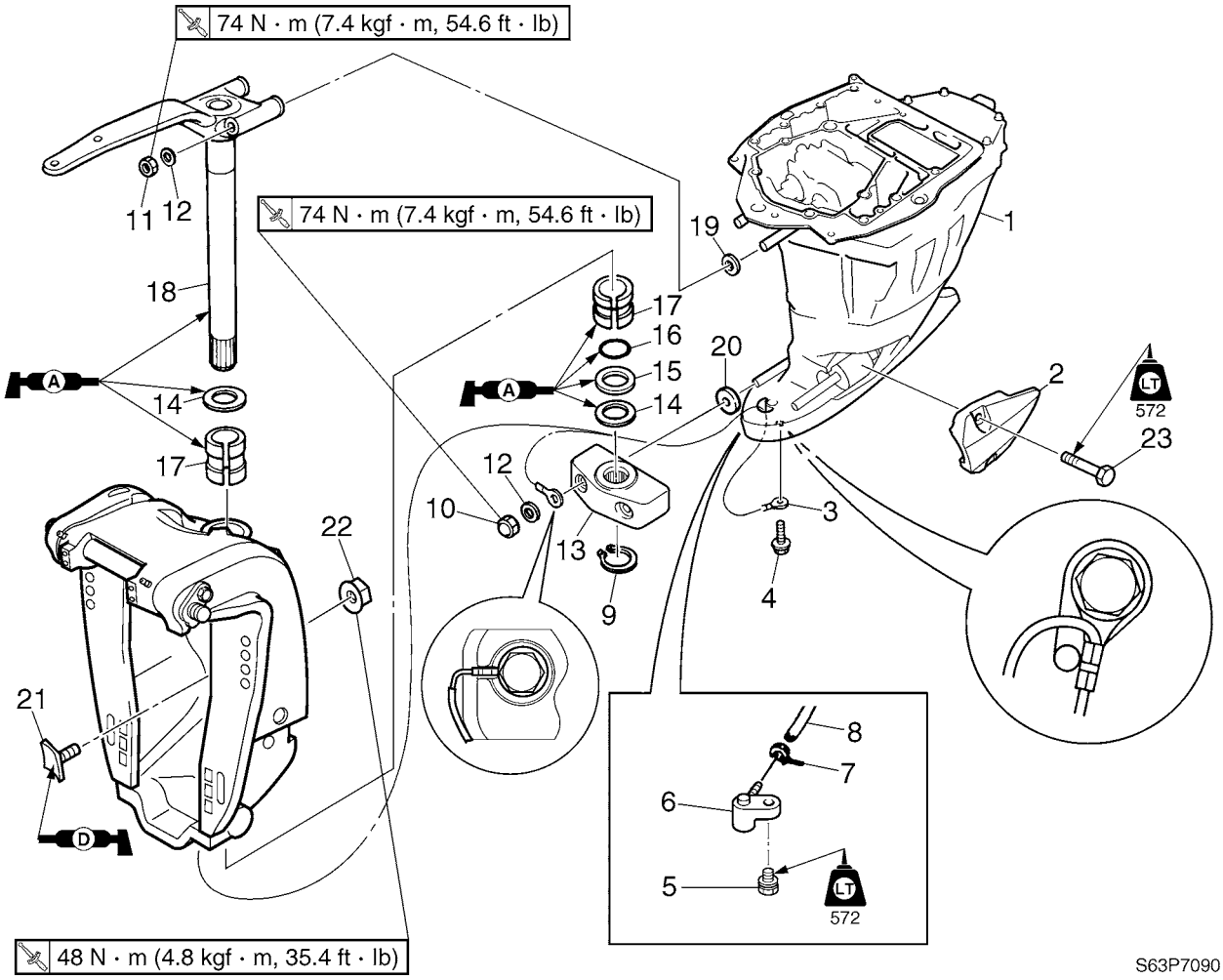
7



S63P7070

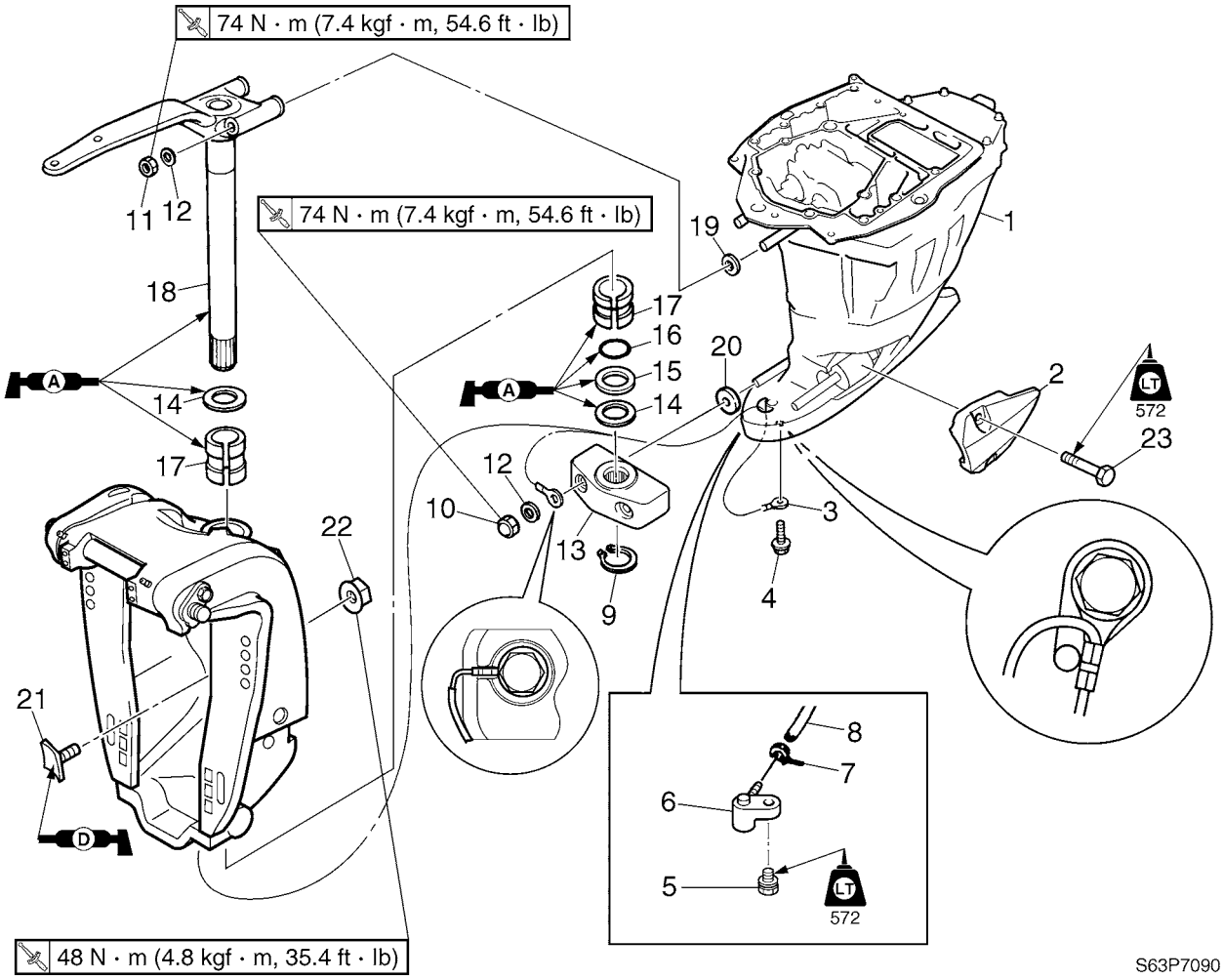
No.	Part name	Q'ty	Remarks
18	Grommet	1	
19	Holder	1	
20	Bolt	1	M6 × 20 mm
21	Retaining plate	1	
22	Bolt	2	M6 × 30 mm
23	Cable holder	1	
24	Bolt	2	M6 × 20 mm
25	Cable holder	1	
26	Bolt	1	M6 × 20 mm
27	Cable holder	1	
28	Bolt	1	M6 × 20 mm
29	Bracket	2	
30	Bolt	4	M6 × 20 mm
31	Power trim and tilt switch	1	
32	Water outlet	1	
33	Cover	1	
34	Rubber trim	1	

Upper case, steering arm, swivel bracket and clamp brackets

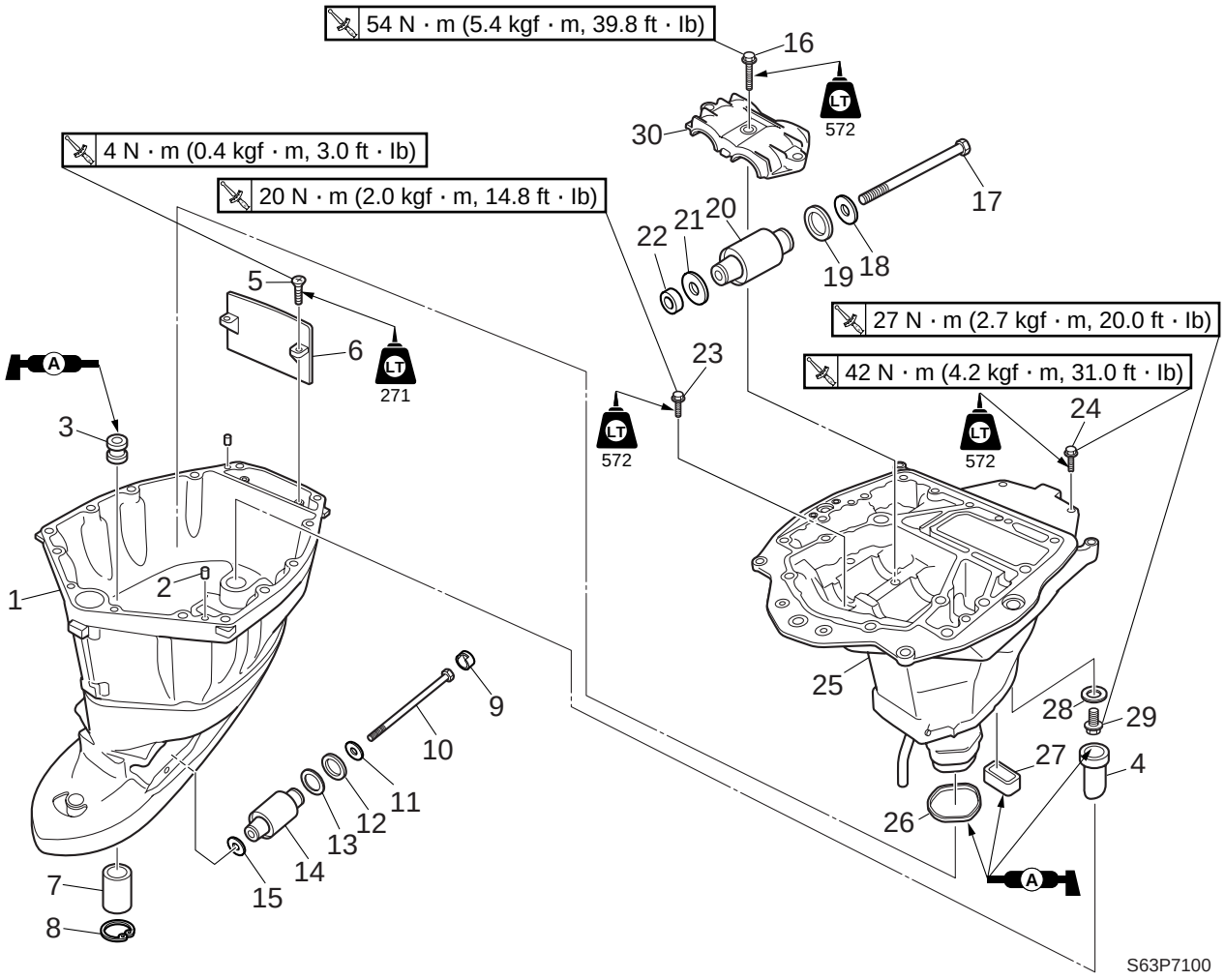


No.	Part name	Q'ty	Remarks
1	Upper case assembly	1	
2	Cover	2	
3	Ground lead	1	
4	Bolt	1	M6 × 10 mm
5	Bolt	1	M6 × 17 mm
6	Adapter	1	
7	Plastic tie	1	**Not reusable**
8	Hose	1	
9	Circlip	1	
10	Nut	2	
11	Nut	2	
12	Washer	4	
13	Steering yoke	1	
14	Washer	2	
15	Bushing	1	
16	O-ring	2	**Not reusable**
17	Bushing	2	

7

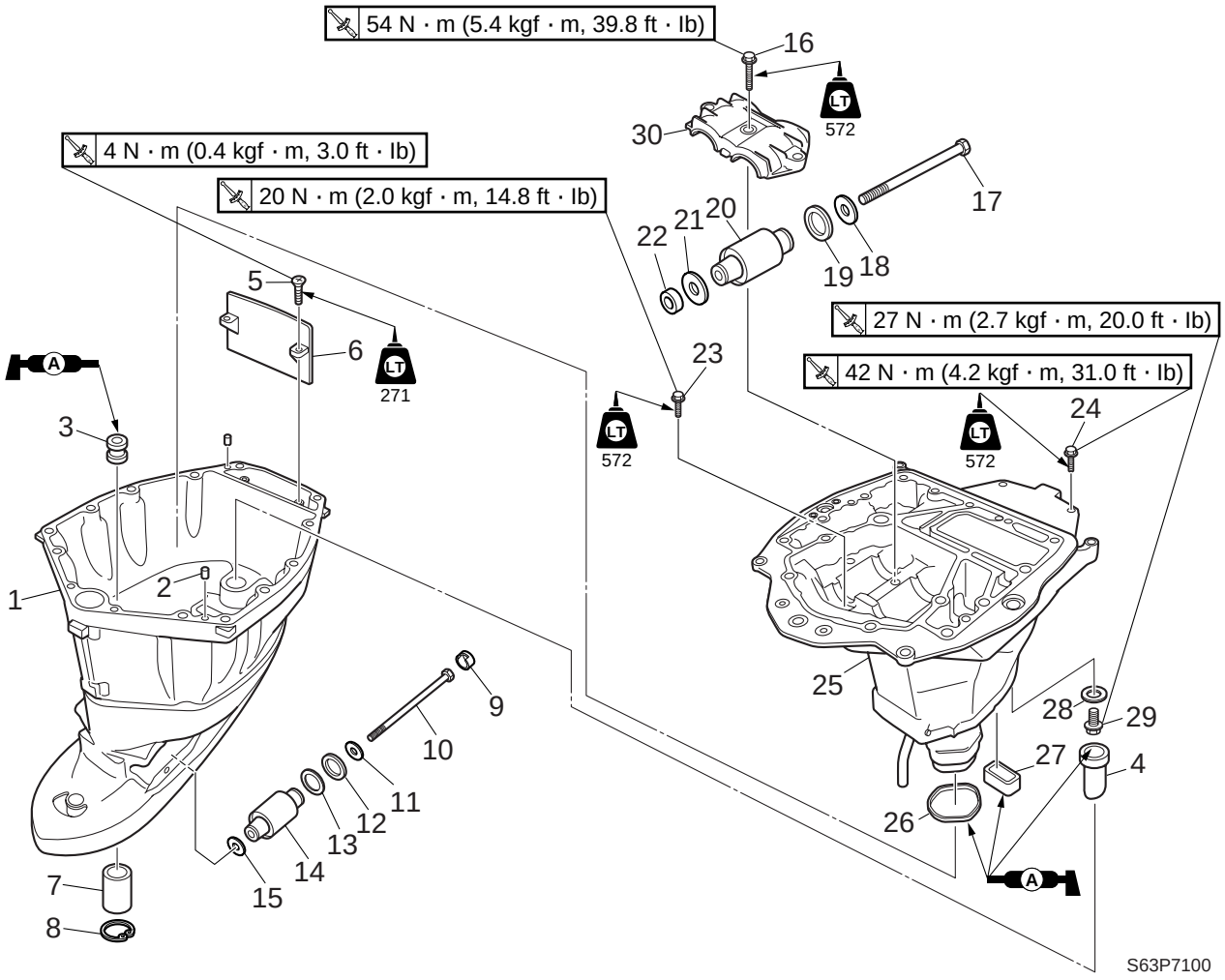


No.	Part name	Q'ty	Remarks
18	Steering arm	1	
19	Washer	2	
20	Washer	2	
21	Trim stopper	2	
22	Nut	2	
23	Bolt	4	

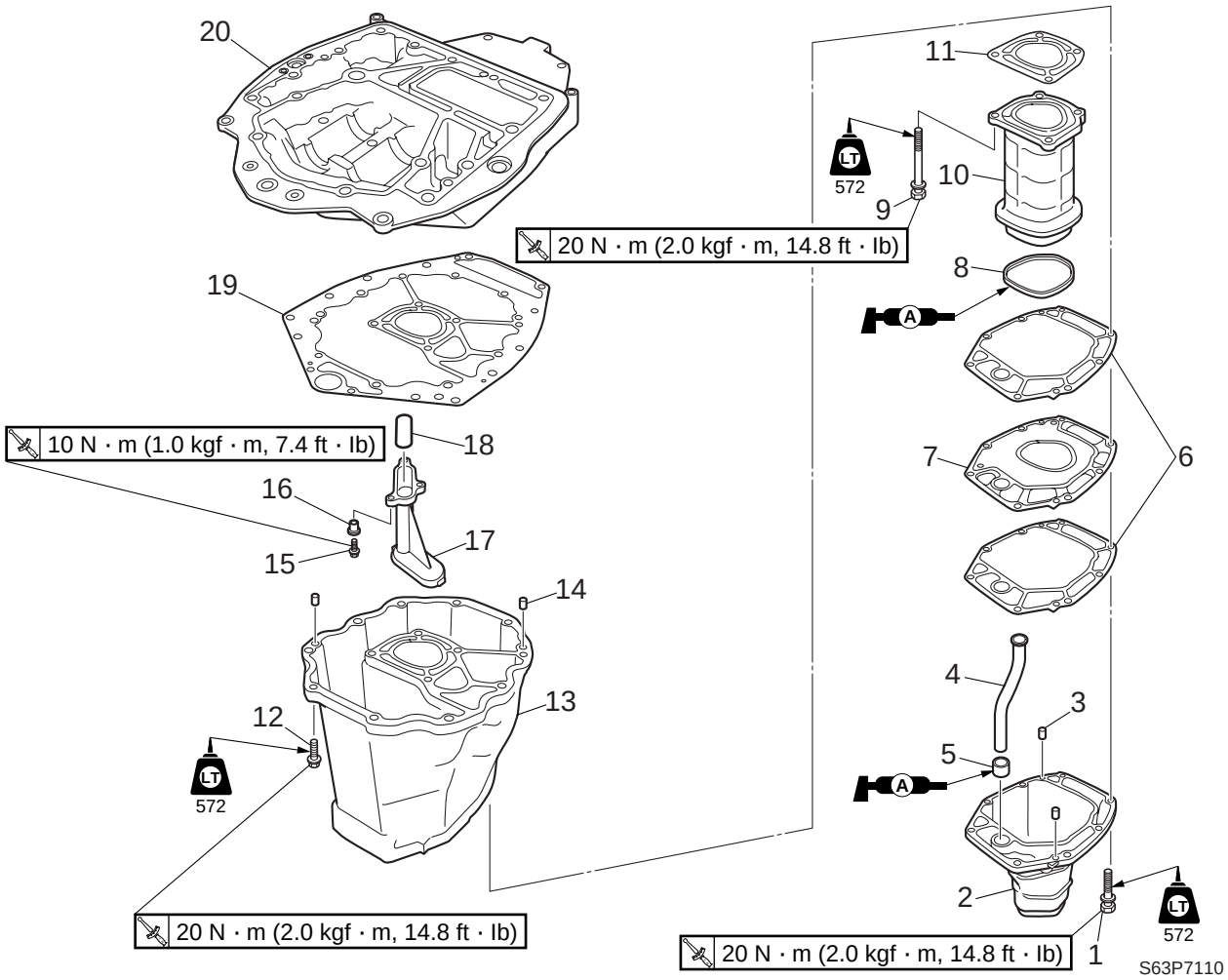

54 N · m (5.4 kgf · m, 39.8 ft · lb)
4 N · m (0.4 kgf · m, 3.0 ft · lb)
20 N · m (2.0 kgf · m, 14.8 ft · lb)
27 N · m (2.7 kgf · m, 20.0 ft · lb)
42 N · m (4.2 kgf · m, 31.0 ft · lb)
LT
572
271
A
S63P7100

No.	Part name	Q'ty	Remarks
1	Upper case	1	
2	Dowel	2	
3	Grommet	1	
4	Damper	1	
5	Screw	2	ø5 × 15 mm
6	Baffle plate	1	
7	Drive shaft bushing	1	
8	Circlip	1	
9	Cap	2	
10	Bolt	2	M14 × 225 mm
11	Washer	2	
12	Washer	2	
13	Washer	2	
14	Lower mount	2	
15	Washer	2	
16	Bolt	3	M10 × 45 mm
17	Bolt	2	M14 × 205 mm

7

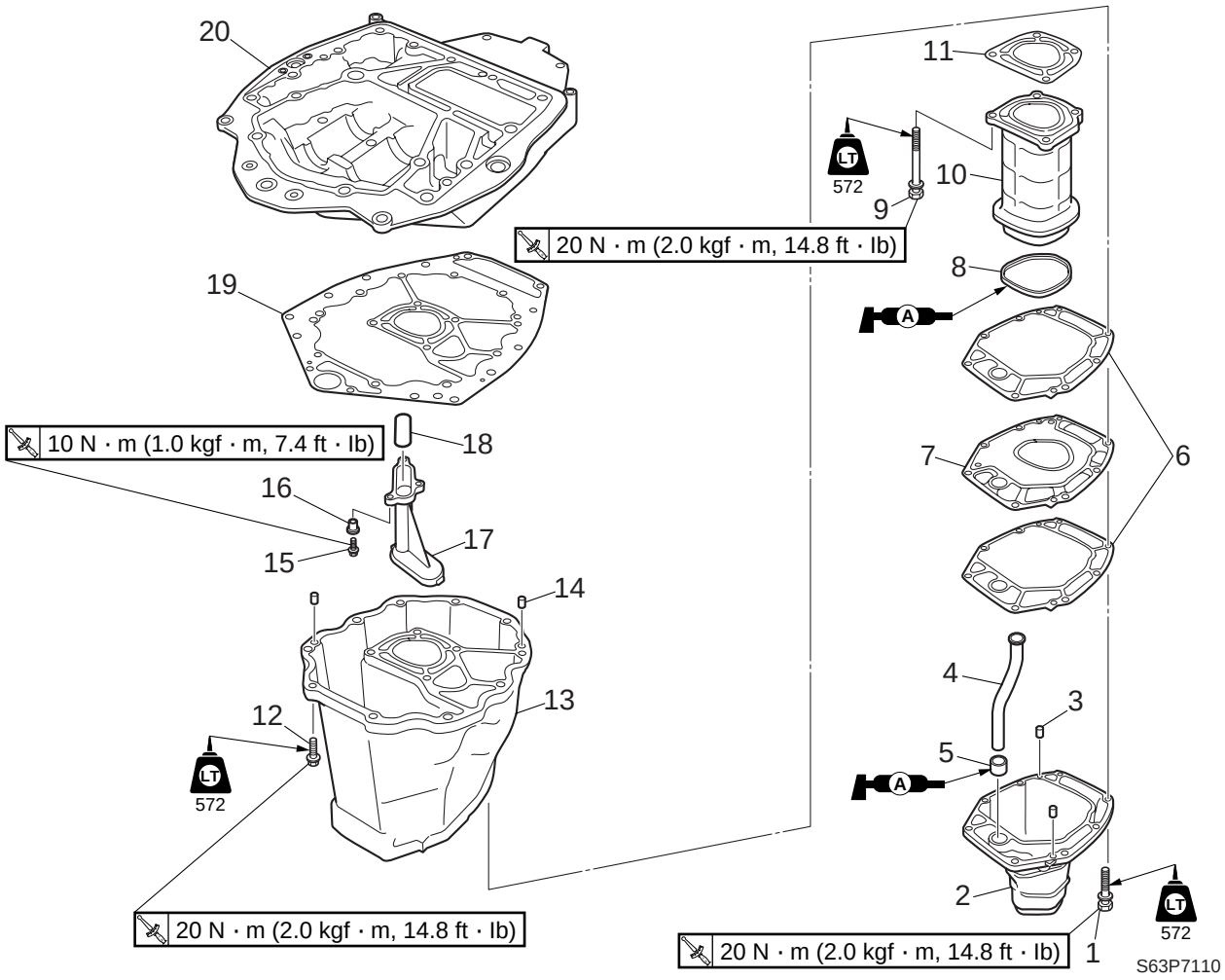

54 N · m (5.4 kgf · m, 39.8 ft · lb)
4 N · m (0.4 kgf · m, 3.0 ft · lb)
20 N · m (2.0 kgf · m, 14.8 ft · lb)
27 N · m (2.7 kgf · m, 20.0 ft · lb)
42 N · m (4.2 kgf · m, 31.0 ft · lb)
LT
572
271
A
S63P7100

No.	Part name	Q'ty	Remarks
18	Washer	2	
19	Washer	2	
20	Upper mount	2	
21	Washer	2	
22	Collar	2	
23	Bolt	2	M8 × 30 mm
24	Bolt	4	M10 × 45 mm
25	Muffler assembly	1	
26	Gasket	1	**Not reusable**
27	Rubber seal	1	
28	Washer	1	
29	Drain bolt	1	M14 × 12 mm
30	Bracket	1	



No.	Part name	Q'ty	Remarks
1	Bolt	8	M8 × 35 mm
2	Muffler	1	
3	Dowel	2	
4	Pipe	1	
5	Rubber seal	1	
6	Gasket	2	**Not reusable**
7	Plate	1	
8	Gasket	1	**Not reusable**
9	Bolt	4	M8 × 60 mm
10	Exhaust manifold	1	
11	Gasket	1	**Not reusable**
12	Bolt	10	M8 × 35 mm
13	Oil pan	1	
14	Dowel	2	
15	Bolt	3	M6 × 25 mm
16	Collar	3	
17	Oil strainer	1	

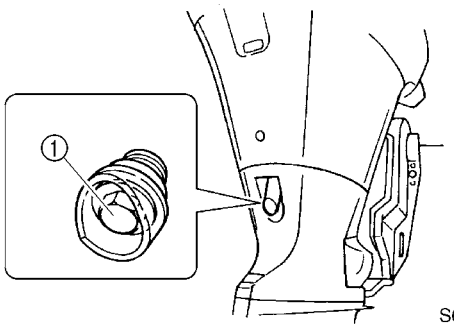
7



No.	Part name	Q'ty	Remarks
18	Gasket	1	**Not reusable**
19	Gasket	1	**Not reusable**
20	Exhaust guide	1	

Draining the engine oil

1. Place a drain pan under the drain hole, and then remove the drain bolt ① and let the oil drain completely.



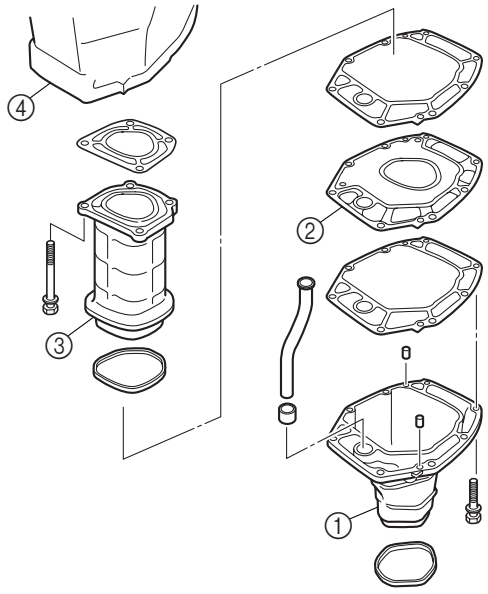
S63P7140

2. Remove the upper and lower mounting nut, and then remove the upper case.

3. Remove the muffler assembly from the upper case.

Disassembling the oil pan

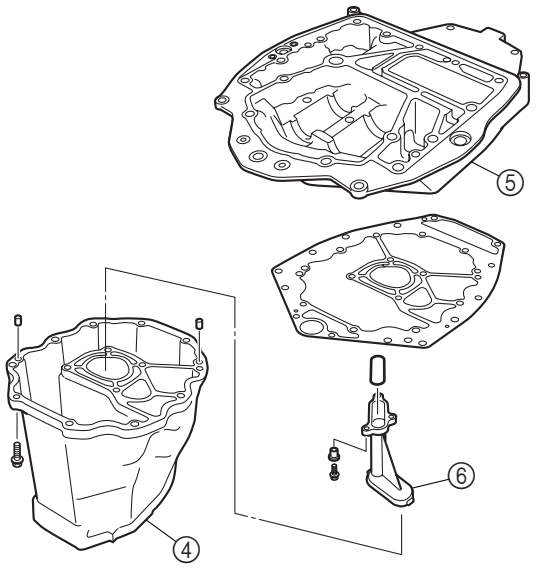
1. Remove the muffler ①, plate ②, and exhaust manifold ③ from the oil pan ④.



S63P7150

2. Remove the oil pan ④ from the exhaust guide ⑤.

3. Remove the oil strainer ⑥ from the exhaust guide ⑤.



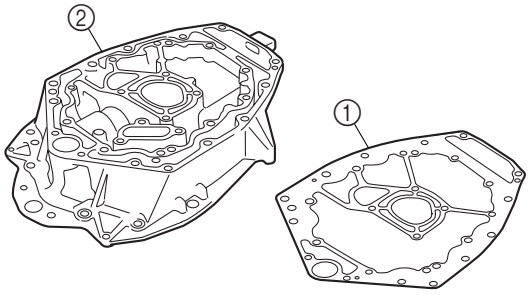
S63P7160

Checking the oil strainer

1. Check the oil strainer for dirt and residue. Clean if necessary.

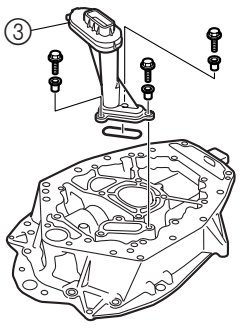
Assembling the oil pan

1. Install the new gasket ① onto the exhaust guide ②.



S63P7170

2. Install the oil strainer ③ and bolts, and then tighten the bolts to the specified torque.



S63P7180

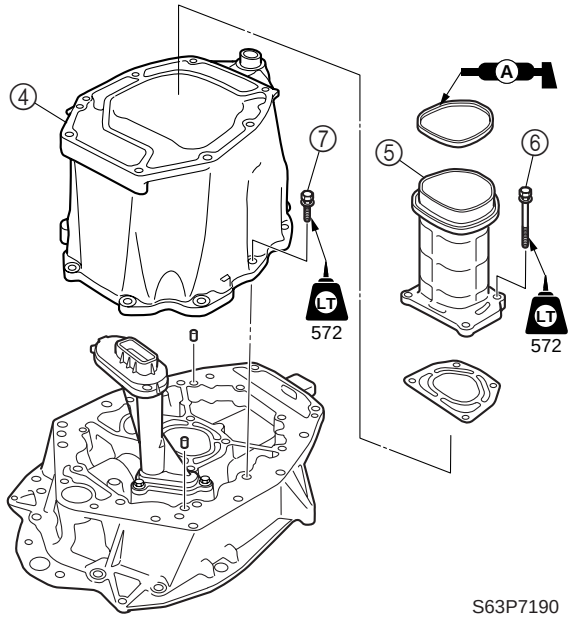
7

Oil strainer bolt:
10 N·m (1.0 kgf·m, 7.4 ft·lb)

3. Install the oil pan ④, and then tighten the bolts finger tight.

4. Install the exhaust manifold ⑤ and bolts, and then tighten the bolts finger tight.

5. Tighten the exhaust manifold bolts ⑥, then the oil pan bolts ⑦, and then tighten them to the specified torques.



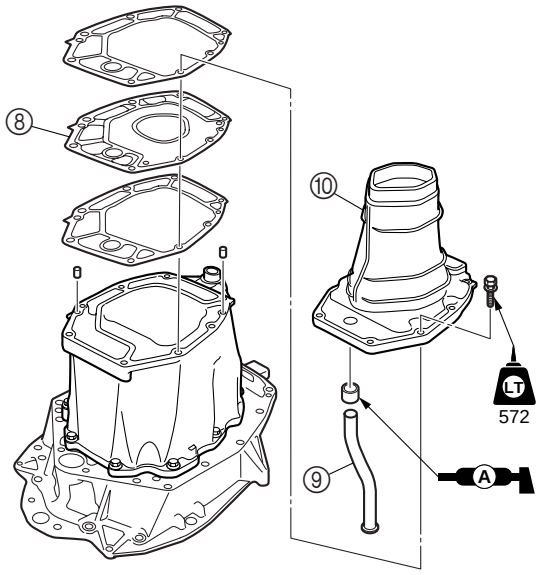
S63P7190

Exhaust manifold bolt ⑥:
20 N·m (2.0 kgf·m, 14.8 ft·lb)
Oil pan bolt ⑦:
20 N·m (2.0 kgf·m, 14.8 ft·lb)

6. Install the plate ⑧.

7. Install the cooling water pipe ⑨ into the muffler ⑩.

8. Install the muffler ⑩ and bolts into the oil pan, and then tighten the bolts to the specified torque.

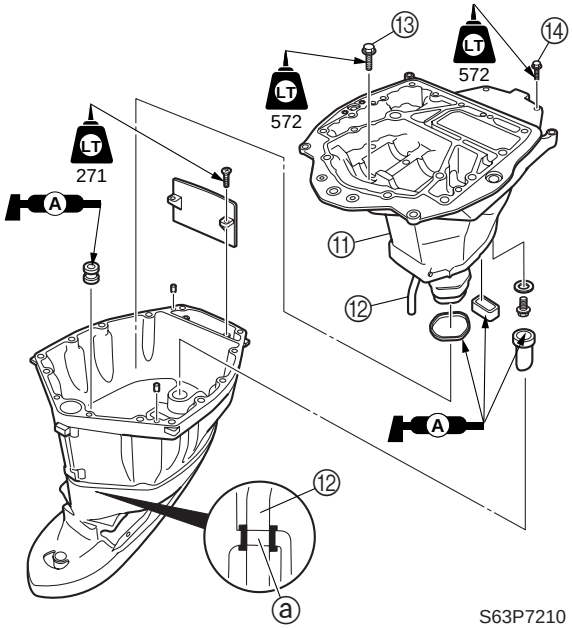


S63P7200

Muffler bolt:
20 N·m (2.0 kgf·m, 14.8 ft·lb)

9. Install the muffler assembly ⑪ by inserting the tip of the cooling water pipe ⑫ into the joint hole ⓐ of the upper case.

10. Install muffler assembly bolts ⑬ and ⑭, and then tighten them to the specified torques.

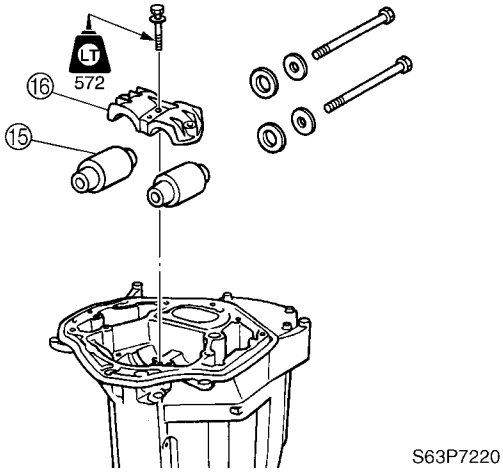


S63P7210

	Muffler assembly bolt ⑬: 20 N·m (2.0 kgf·m, 14.8 ft·lb) Muffler assembly bolt ⑭: 42 N·m (4.2 kgf·m, 31.0 ft·lb)

11. Install the upper mounts ⑮ and bolts into the upper case.

12. Install the bracket ⑯ and bolts, and then tighten the bolts to the specified torque.



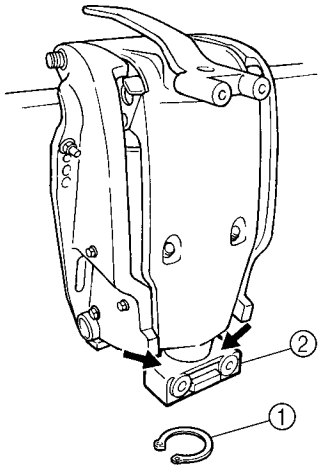
S63P7220

	Upper mount bracket bolt: 54 N·m (5.4 kgf·m, 39.8 ft·lb)

Removing the steering arm

1. Remove the circlip ①.

2. Remove the steering yoke ② by striking it with a plastic hammer.



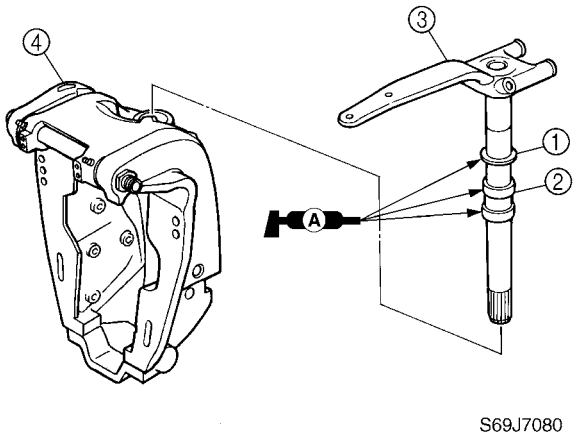
S69J7075

3. Remove the steering arm from the swivel bracket by pulling the arm off the bracket.

Installing the steering arm

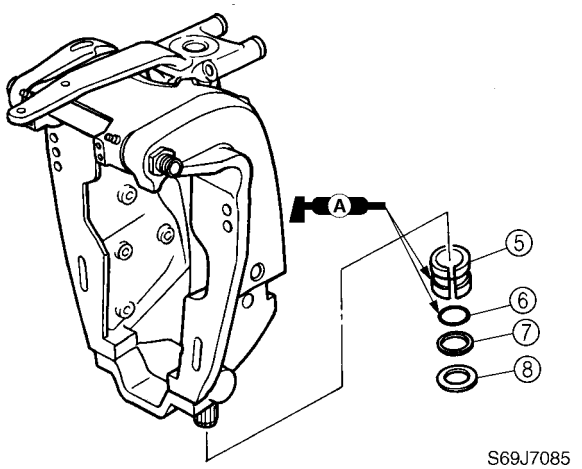
1. Install the washer ① and bushing ② onto the steering arm ③.

2. Place the swivel bracket ④ in an upright position, and then install the steering arm onto the swivel bracket.



S69J7080

3. Install the bushing ⑤, new O-ring ⑥, bushing ⑦, and washer ⑧ onto the swivel bracket.

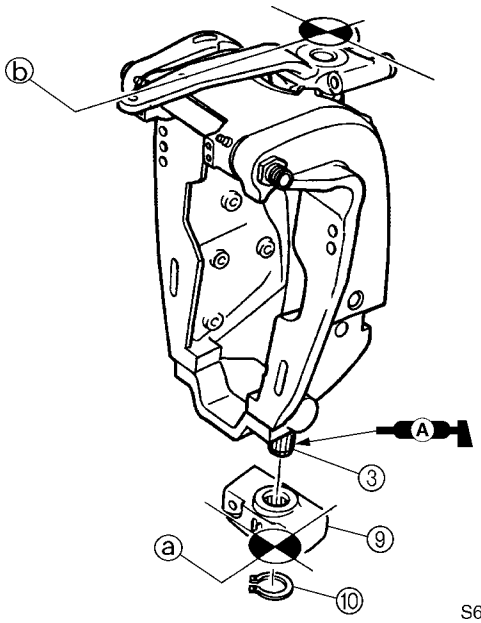


S69J7085

7

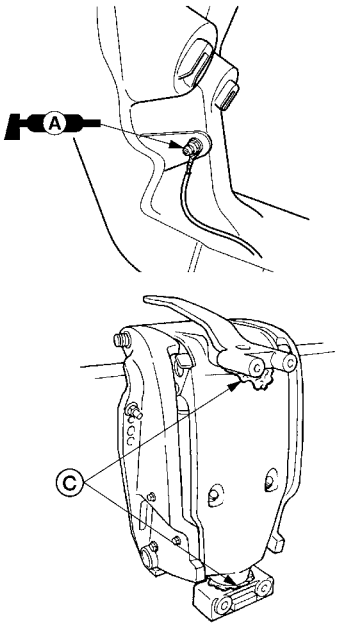
4. Install the steering yoke ⑨ to the steering arm ③ by aligning the center ⓐ of the yoke with the center ⓑ of the steering arm.

5. Install the circlip ⑩.



S69J7090

6. Inject grease into the grease nipple until grease comes out from both the upper and lower bushings ⓒ.



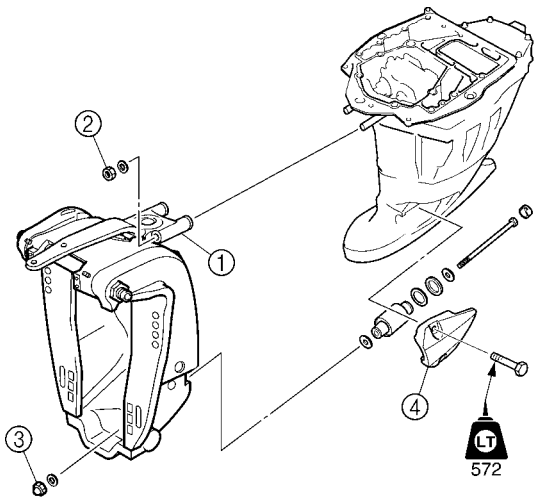
S69J7095

Installing the upper case

1. Install the upper and lower mounting bolts into the swivel bracket ① simultaneously.

2. Install the upper mounting nut ② and lower mounting nut ③, and then tighten them to the specified torques.

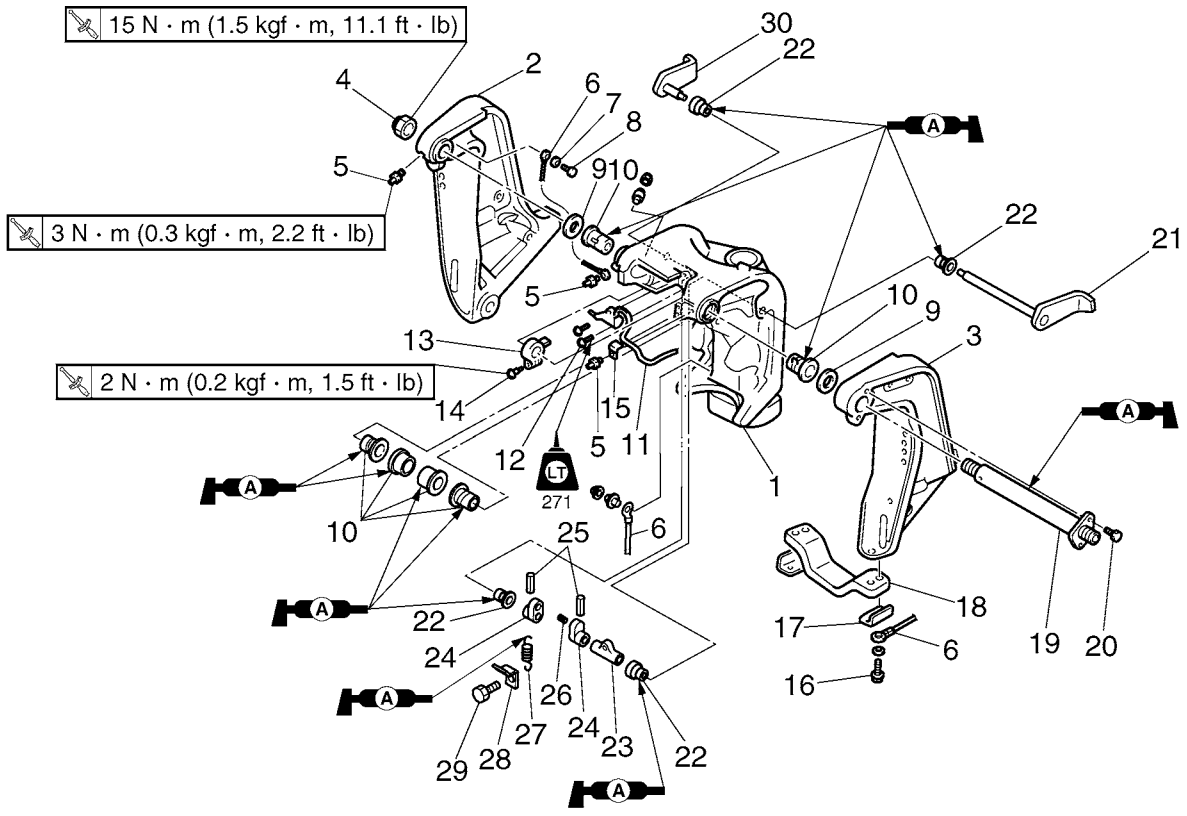
3. Install the covers ④.



S63P7240

	Upper mounting nut ②: 74 N·m (7.4 kgf·m, 54.6 ft·lb) Lower mounting nut ③: 74 N·m (7.4 kgf·m, 54.6 ft·lb)

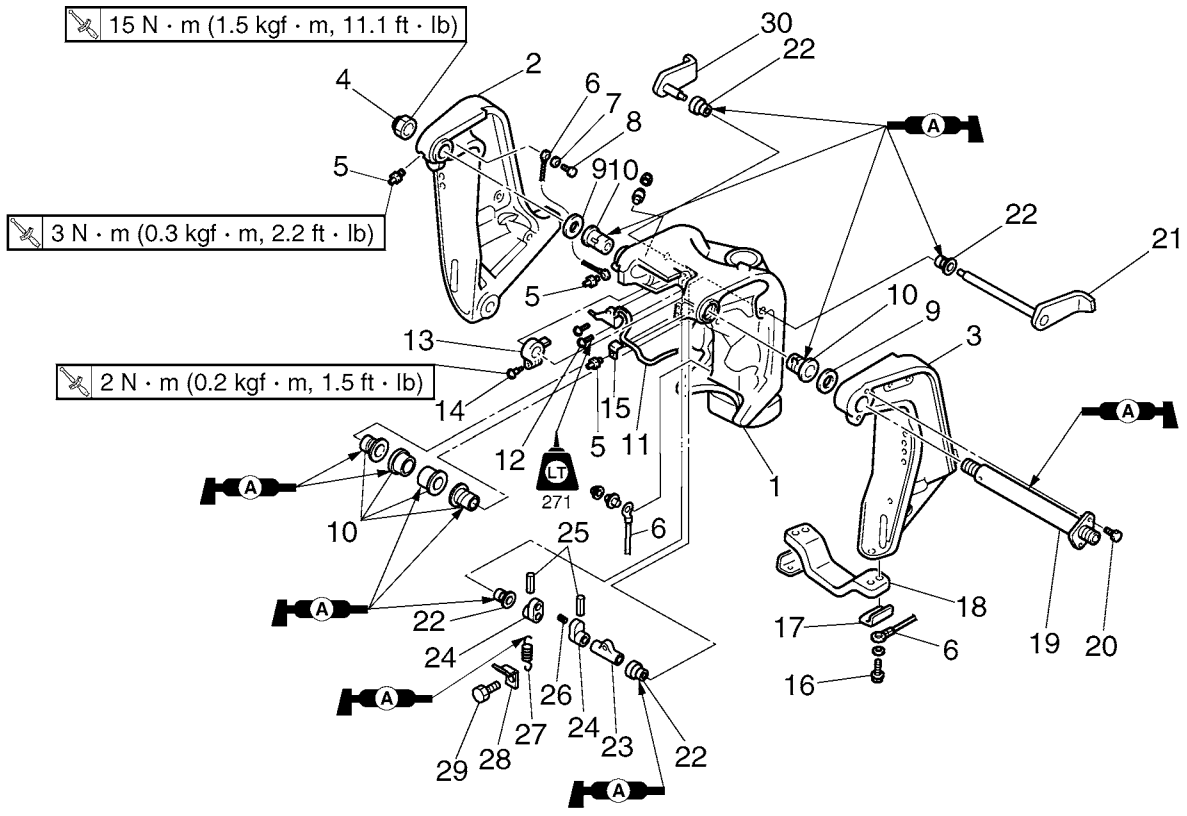
Clamp brackets



S63P7130

No.	Part name	Q'ty	Remarks
1	Swivel bracket	1	
2	Clamp bracket	1	
3	Clamp bracket	1	
4	Self-locking nut	1	
5	Grease nipple	6	
6	Ground lead	3	
7	Washer	1	
8	Bolt	1	M6 × 11 mm
9	Washer	2	
10	Bushing	6	
11	Trim sensor	1	
12	Screw	2	ø6 × 15 mm
13	Trim sensor cam	1	
14	Screw	1	ø6 × 25 mm
15	Clamp	1	
16	Bolt	4	M6 × 30 mm
17	Bracket	2	

7



S63P7130

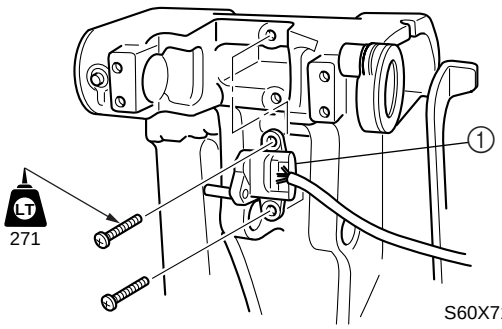
No.	Part name	Q'ty	Remarks
18	Anode	1	
19	Through tube	1	
20	Bolt	1	M8 × 20 mm
21	Tilt stop lever	1	
22	Bush	4	
23	Collar	1	
24	Distance collar	2	
25	Spring pin	2	
26	Pin	1	
27	Spring	1	
28	Spring hook	1	
29	Bolt	1	M6 × 10 mm
30	Tilt stop lever	1	

Removing the clamp brackets

1. Remove the power trim and tilt unit. For removal procedures, see “Removing the power trim and tilt unit.”
2. Remove the anode.
3. Remove the bolt and grease nipples, and then disconnect the ground leads.
4. Remove the self-locking nut and bolt.
5. Remove the through tube, then disassemble the clamp brackets, trim sensor cam, and swivel bracket.
6. Remove the trim sensor.
7. Remove the tilt stop levers.

Installing the clamp brackets

1. Install the tilt stop levers onto the swivel bracket assembly.
2. Install the trim sensor ① and bushings onto the swivel bracket assembly.



3. Assemble the clamp brackets, washers, and swivel bracket, and then install the through tube.

NOTE:
- Make sure that the trim sensor cam is installed between the swivel bracket holes.
- Adjust the trim sensor cam after assembly.

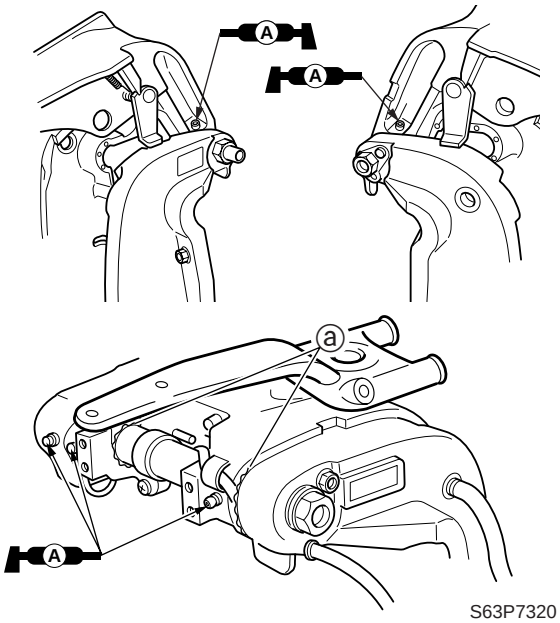
4. Install the bolts on the through tube, and then tighten the self-locking nut to the specified torque.

	Self-locking nut: 15 N·m (1.5 kgf·m, 11.1 ft·lb)

5. Install the power trim and tilt unit, then the anode.

NOTE:
Install the ground lead between the power trim and tilt unit and the anode.

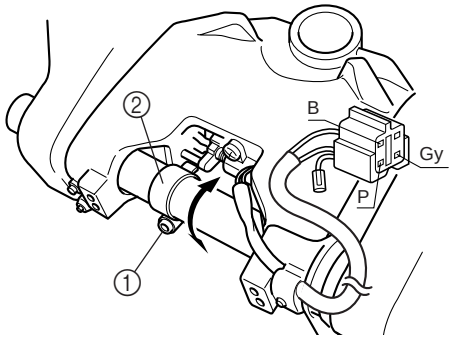
6. Install the ground lead between the clamp brackets and the swivel bracket.
7. Apply water resistant grease through the grease nipples.



NOTE:
Apply the grease until it comes out of the bushing ⓐ.

Adjusting the trim sensor cam

1. Fully retract the power trim and tilt unit.
2. Loosen the trim sensor cam screw ①.
3. Adjust the trim sensor cam ② where the specified trim sensor setting resistance is obtained.

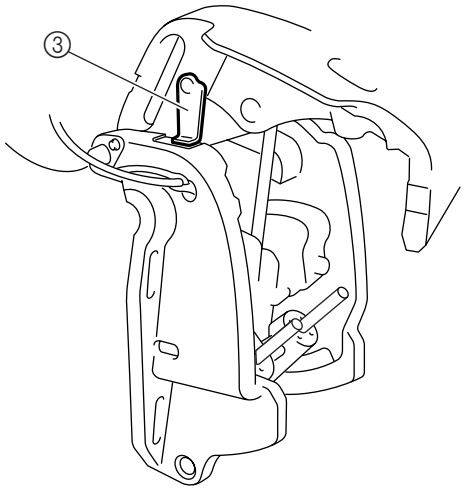


S60X7160

Trim sensor setting resistance:
Pink (P) – Black (B)
9–11 Ω at 20 °C (68 °F)

Trim sensor cam screw ①:
2 N·m (0.2 kgf·m, 1.5 ft·lb)

4. Fully tilt the outboard motor up, and then support it with the tilt stop lever ③.



S60X7170

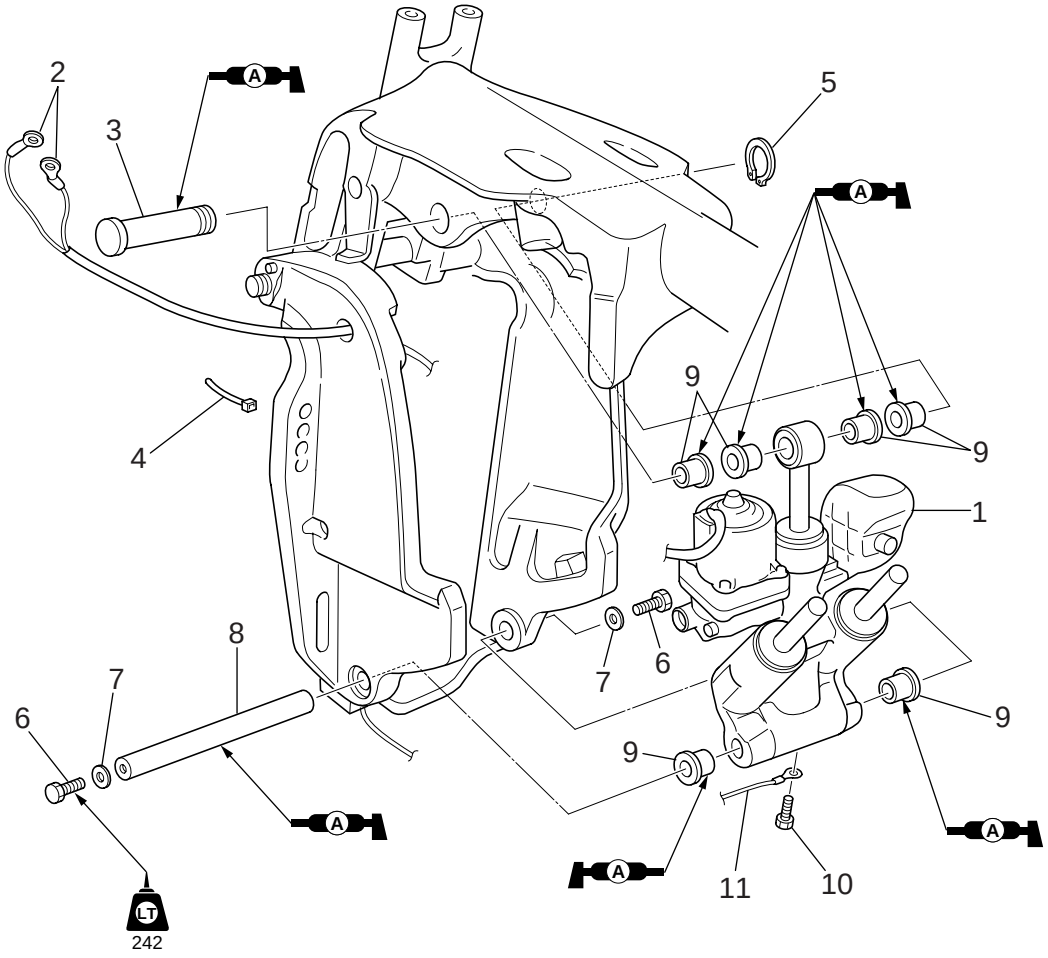
⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

5. Check the trim sensor resistance. If the resistance is out of specification, adjust the trim sensor cam position and check the trim sensor.

Trim sensor resistance:
Pink (P) – Black (B)
238.8–378.8 Ω at 20 °C (68 °F)

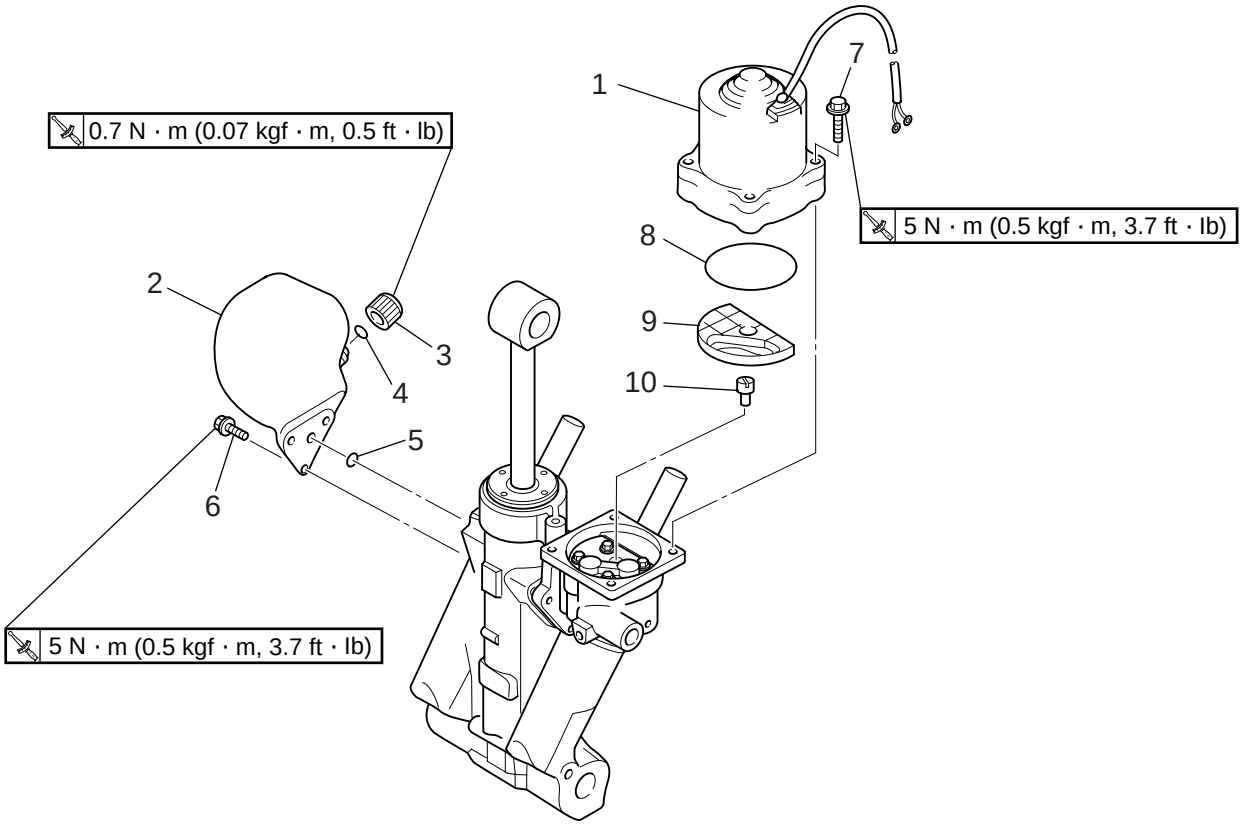
Power trim and tilt unit



S60X7010

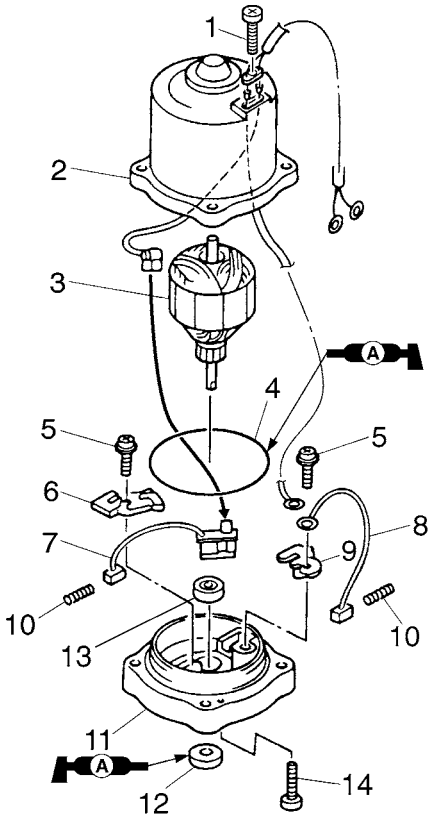
No.	Part name	Q'ty	Remarks
1	Power trim and tilt unit	1	
2	PTT motor lead	2	
3	Shaft	1	
4	Plastic tie	3	**Not reusable**
5	Circlip	1	
6	Bolt	2	M8 × 16 mm
7	Washer	2	
8	Shaft	1	
9	Bushing	6	
10	Bolt	1	M6 × 10 mm
11	Ground lead	1	

7



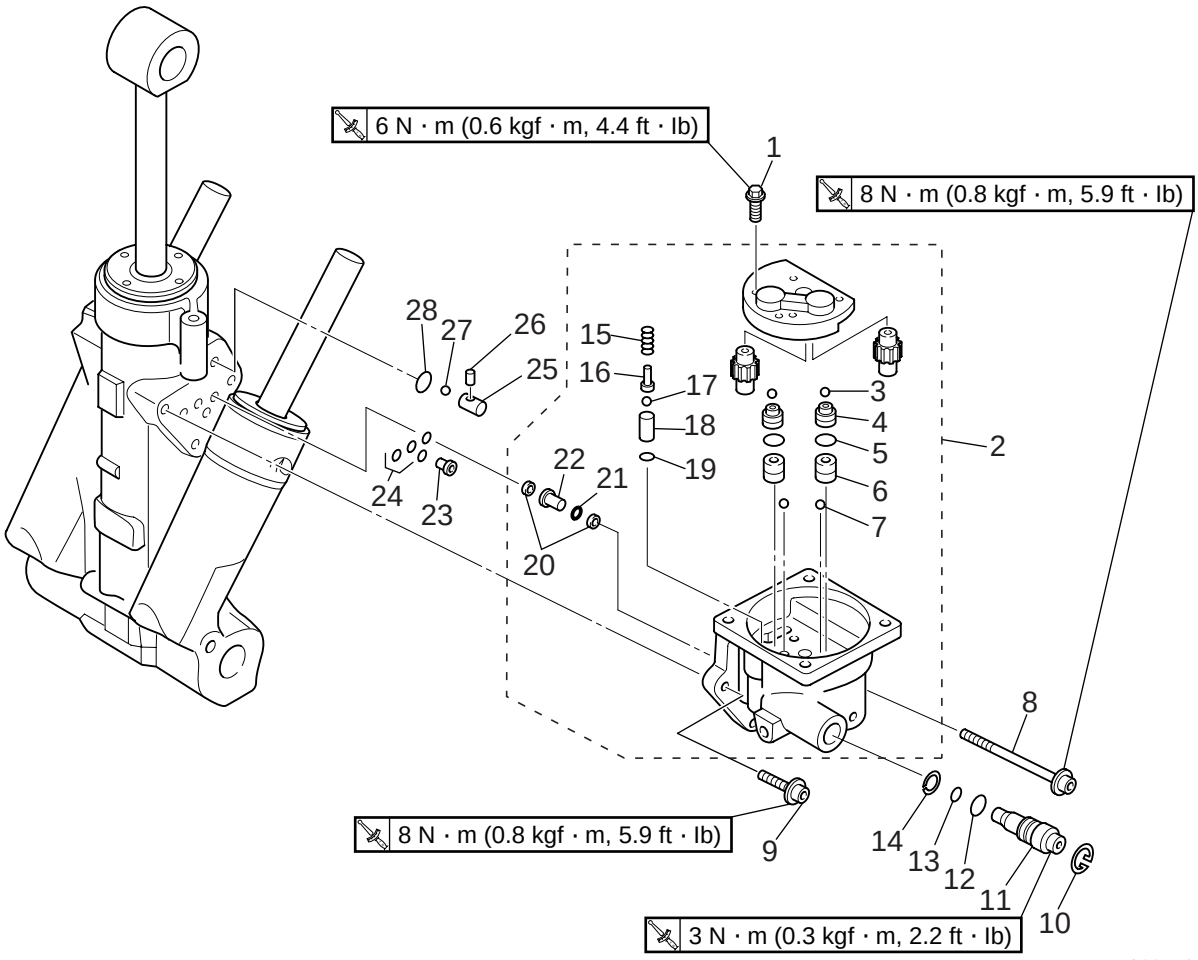
S60X7180

No.	Part name	Q'ty	Remarks
1	Power trim and tilt motor	1	
2	Reservoir	1	
3	Reservoir cap	1	
4	O-ring	1	
5	O-ring	1	**Not reusable**
6	Bolt	3	M6 × 14 mm
7	Bolt	4	M6 × 35 mm
8	O-ring	1	**Not reusable**
9	Filter	1	
10	Joint	1	

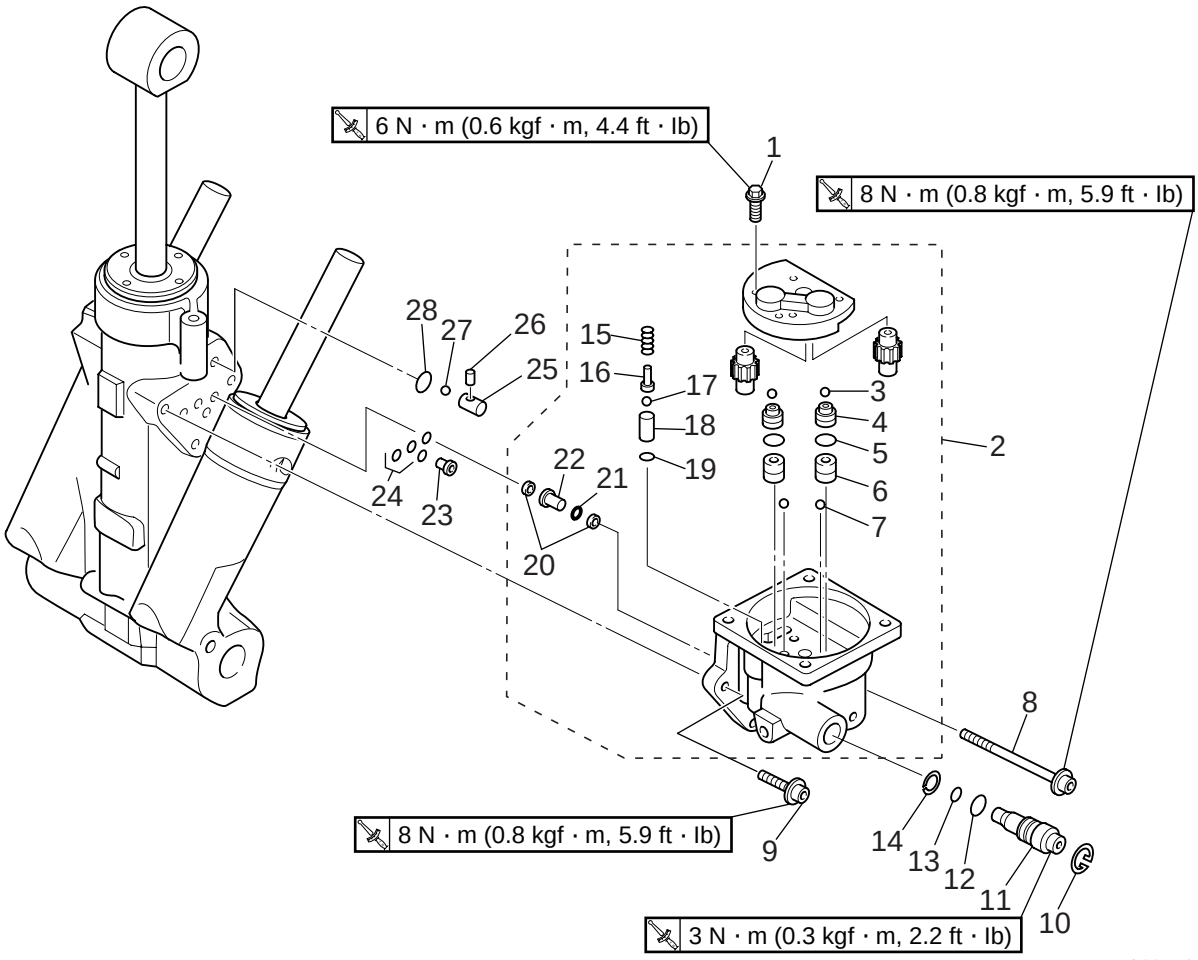


S60X7190

No.	Part name	Q'ty	Remarks
1	Screw	1	ø4 × 15 mm
2	Stator	1	
3	Armature	1	
4	O-ring	1	**Not reusable**
5	Screw	2	ø4 × 12 mm
6	Brush holder	1	
7	Brush 2	1	
8	Brush 1	1	
9	Brush holder	1	
10	Brush spring	2	
11	PTT motor base	1	
12	Oil seal	1	**Not reusable**
13	Bearing	1	**Not reusable**
14	Screw	2	ø4 × 15 mm

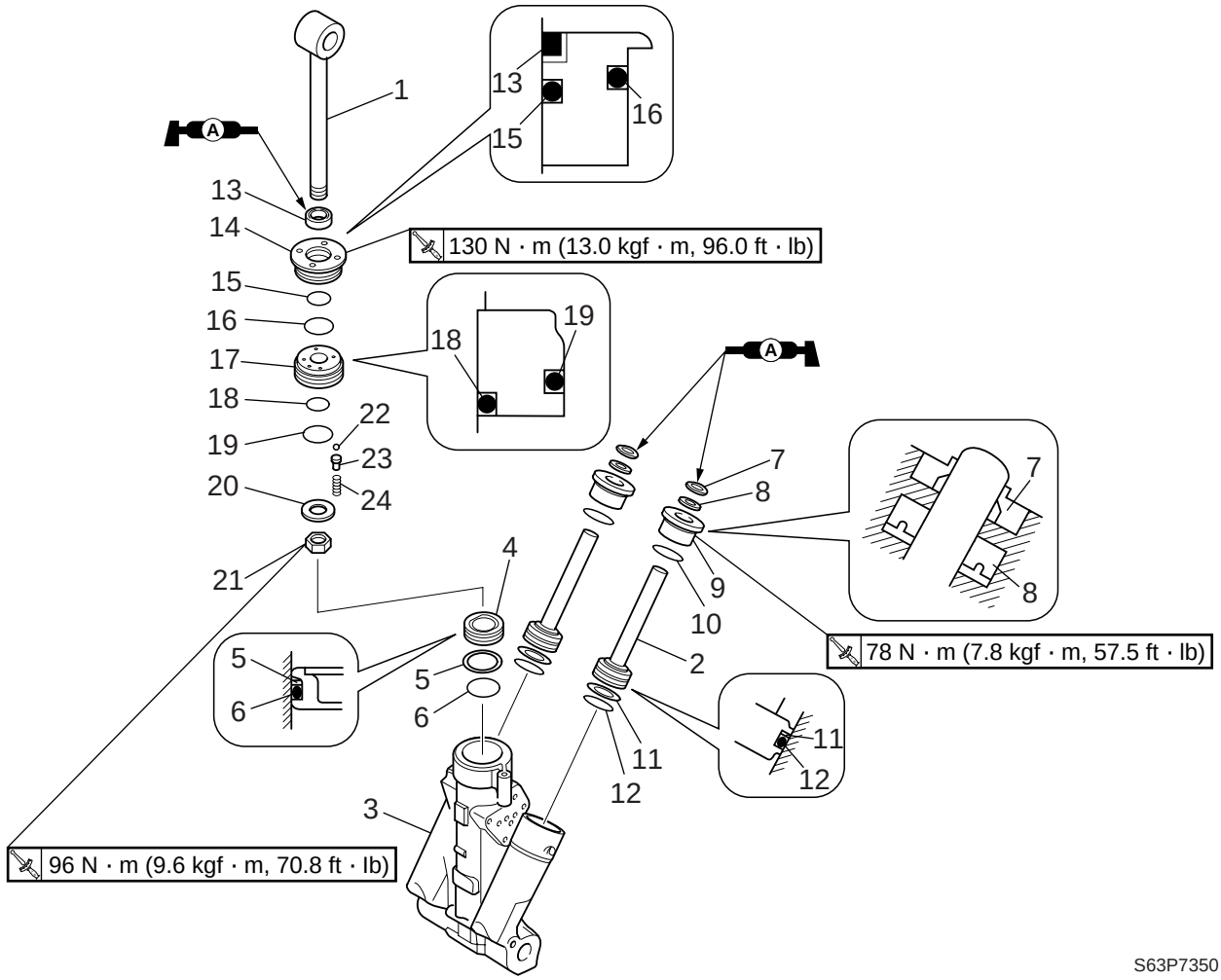


No.	Part name	Q'ty	Remarks
1	Bolt	4	M5 × 16 mm
2	Gear pump assembly	1	
3	Ball	2	
4	Shuttle piston	2	
5	O-ring	2	**Not reusable**
6	Main valve	2	
7	Ball	2	
8	Bolt	1	
9	Bolt	2	
10	Circlip	1	
11	Manual valve	1	
12	O-ring	1	**Not reusable**
13	O-ring	1	**Not reusable**
14	Backup ring	1	
15	Spring	1	
16	Absorber valve pin	1	
17	Ball	1	

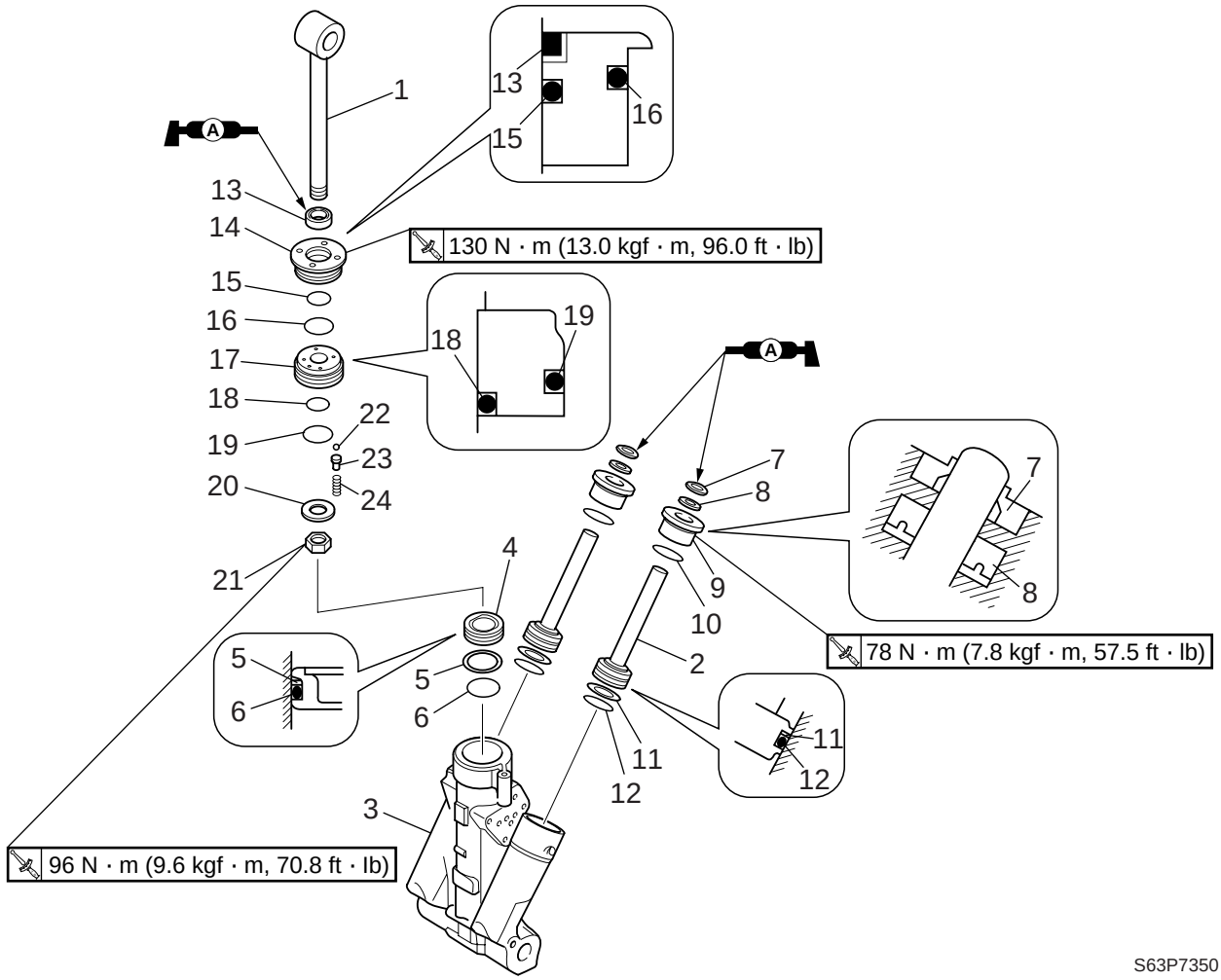


No.	Part name	Q'ty	Remarks
18	Up-relief valve seat	1	
19	O-ring	1	**Not reusable**
20	Filter	2	
21	O-ring	1	**Not reusable**
22	Down-relief valve	1	
23	Valve pin	1	
24	O-ring	4	**Not reusable**
25	Valve seat	1	
26	Pin	1	
27	Ball	1	
28	O-ring	1	**Not reusable**

7



No.	Part name	Q'ty	Remarks
1	Tilt ram	1	
2	Trim ram	2	
3	Cylinder body	1	
4	Free piston	1	
5	Backup ring	1	
6	O-ring	1	Not reusable
7	Dust seal	2	Not reusable
8	Seal	2	Not reusable
9	Trim cylinder end screw	2	
10	O-ring	2	Not reusable
11	Backup ring	2	
12	O-ring	2	Not reusable
13	Dust seal	1	Not reusable
14	Tilt cylinder end screw	1	
15	O-ring	1	Not reusable
16	O-ring	1	Not reusable
17	Tilt piston	1	

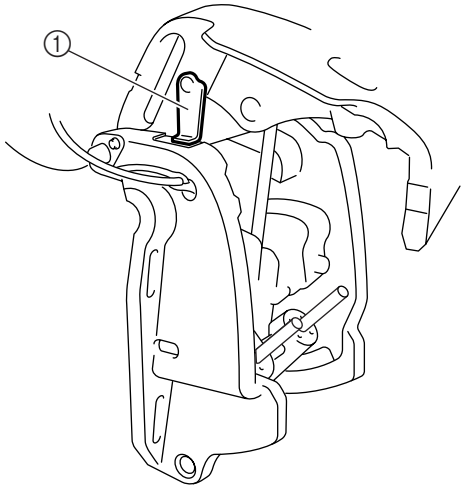


No.	Part name	Q'ty	Remarks
18	O-ring	1	**Not reusable**
19	O-ring	1	**Not reusable**
20	Washer	1	
21	Nut	1	
22	Ball	4	
23	Valve	4	
24	Spring	4	

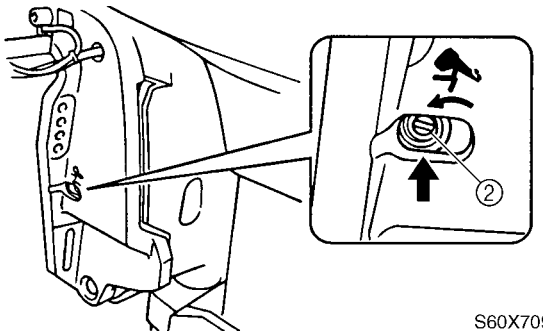
7

Removing the power trim and tilt unit

1. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.



S60X3020



S60X7090

⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

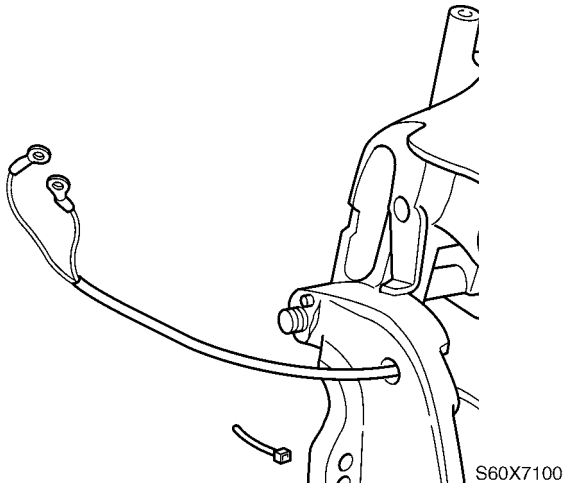
NOTE:

- If the power trim and tilt does not operate, loosen the manual valve ② and tilt the outboard motor up manually.
- If the manual valve is loosened, be sure to tighten it to the specified torque after tilting the outboard motor up.

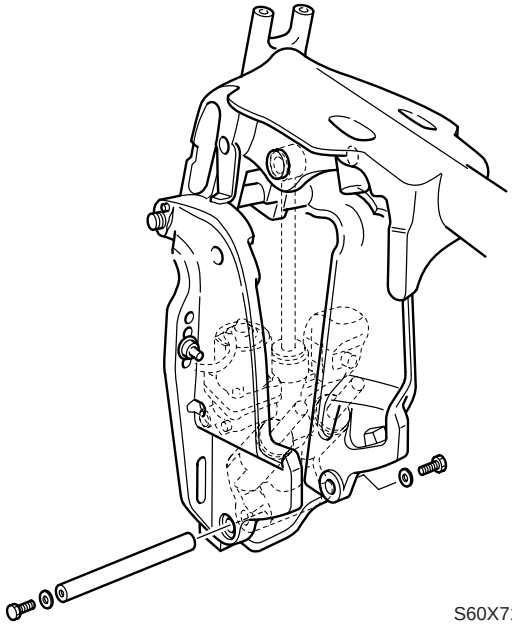
	Manual valve: 3 N·m (0.3 kgf·m, 2.2 ft·lb)

2. Remove the bolt and disconnect the ground lead at the bottom of the power trim and tilt unit.

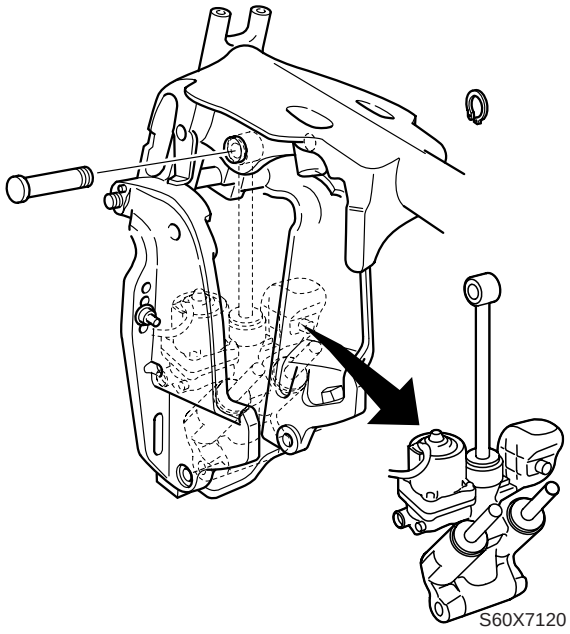
3. Remove the plastic ties, and then pull out the PTT motor leads.


S60X7100

4. Remove the bolts, then the lower mounting shaft.


S60X7110

5. Remove the circlip, then the upper mounting shaft.

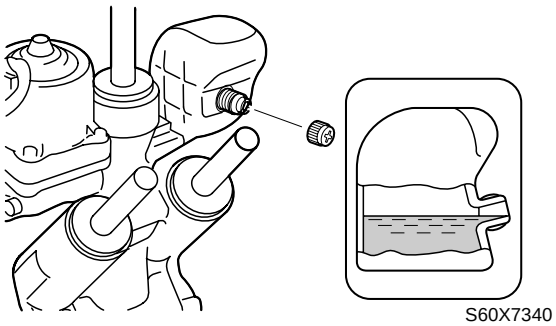

S60X7120

NOTE:
Hold the power trim and tilt unit with one hand, and pull the upper mount shaft out at a downward angle with the other.

6. Remove the collars.

Checking the hydraulic pressure

1. Remove the reservoir cap, and then check the fluid level in the reservoir.


S60X7340

NOTE:
If the fluid is at the correct level, the fluid should overflow out of the filler hole when the reservoir cap is removed.

2. If necessary, add sufficient fluid of the recommended type until it overflows out of the filler hole.

Recommended power trim and tilt fluid:
ATF Dexron II

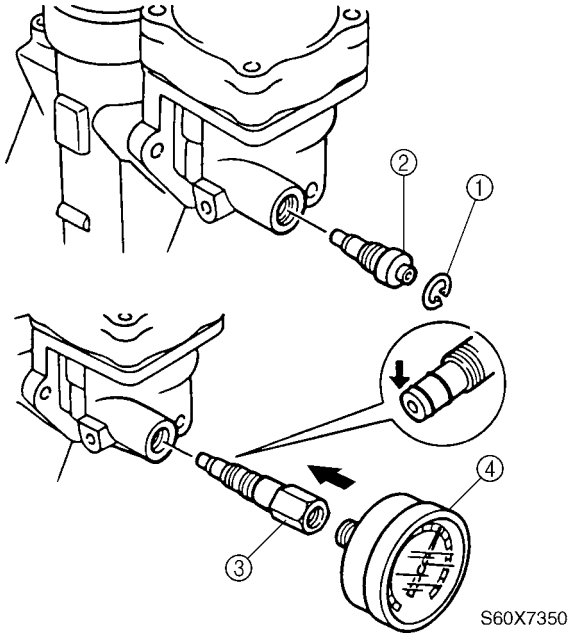
3. Install the reservoir cap, and then tighten it to the specified torque.

Reservoir cap:
0.7 N·m (0.07 kgf·m, 0.5 ft·lb)

4. Fully extend the trim and tilt rams.

5. Remove the circlip ①, then the manual valve ②.

6. Install the up relief fitting ③ and hydraulic pressure gauge ④.



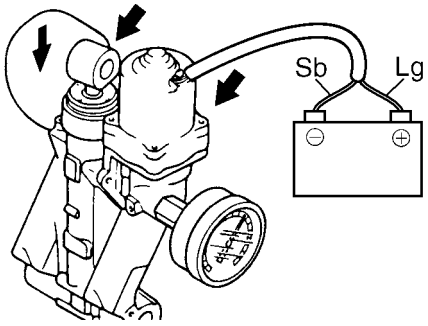
S60X7350

NOTE:
Quickly install the special service tools before any fluid flows out of the hole.

Up relief fitting ③: 90890-06773
Hydraulic pressure gauge ④:
90890-06776

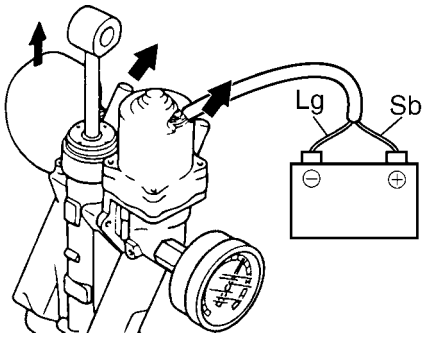
7

7. Connect the PTT motor leads to the battery terminals to fully retract the trim and tilt rams.



Rams	PTT motor lead	Battery terminal
Down	Light green (Lg)	⊕
	Sky blue (Sb)	⊖

8. Reverse the PTT motor leads between the battery terminals to fully extend the trim and tilt rams, and then measure the hydraulic pressure.

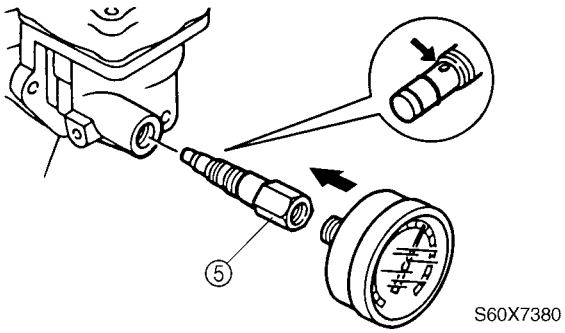


Rams	PTT motor lead	Battery terminal
Up	Sky blue (Sb)	⊕
	Light green (Lg)	⊖

Hydraulic pressure (up):
10–12 MPa (100–120 kgf/cm^2)

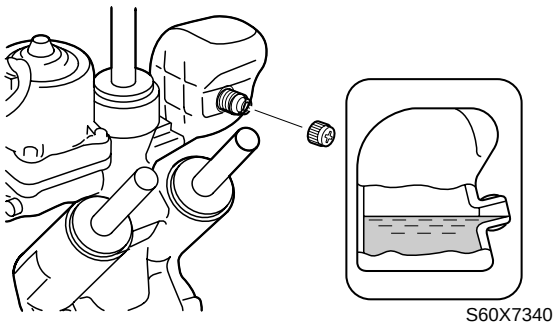
9. Replace the up relief fitting with the down relief fitting ⑤.

NOTE:
Quickly install the special service tools before any fluid flows out of the hole.



Down relief fitting ⑤: 90890-06774
Hydraulic pressure gauge:
90890-06776

10. Remove the reservoir cap, and then check the fluid level.



NOTE:
If the fluid is at the correct level, the fluid should overflow out of the filler hole when the reservoir cap is removed.

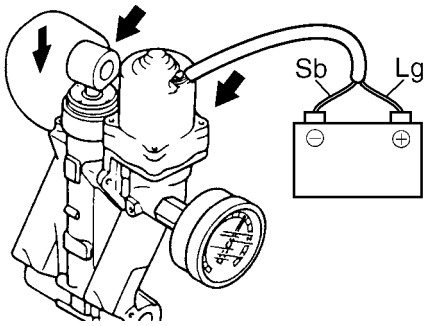
11. If necessary, add sufficient fluid of the recommended type until it overflows out of the filler hole.

Recommended power trim and tilt fluid:
ATF Dexron II

12. Install the reservoir cap, and then tighten it to the specified torque.

Reservoir cap:
0.7 N·m (0.07 kgf·m, 0.5 ft·lb)

13. Connect the PTT motor leads to the battery terminals to fully retract the trim and tilt rams, and then measure the hydraulic pressure. If out of specification, overhaul the power trim and tilt unit.

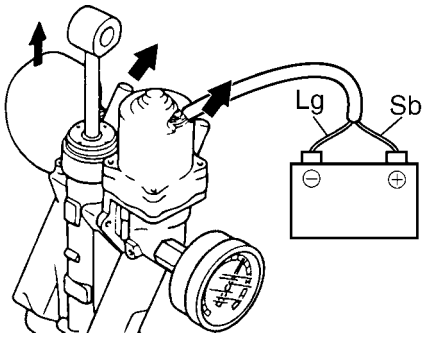


S63P7300

Rams	PTT motor lead	Battery terminal
Down	Light green (Lg)	⊕
	Sky blue (Sb)	⊖

Hydraulic pressure (down):
6–9 MPa (60–90 kgf/cm^2)

14. Reverse the PTT motor leads between the battery terminals to fully extend the trim and tilt rams.



S63P7310

Rams	PTT motor lead	Battery terminal
Up	Sky blue (Sb)	⊕
	Light green (Lg)	⊖

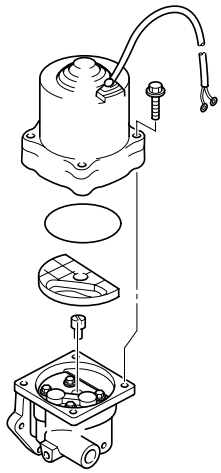
15. Remove the special service tools, and then install the manual valve and circlip.

Manual valve:
3 N·m (0.3 kgf·m, 2.2 ft·lb)

NOTE:
Quickly install the manual valve before any fluid flows out of the hole.

Disassembling the power trim and tilt motor

1. Remove the power trim and tilt motor, O-ring, gear pump filter, and joint from the gear pump housing.


S60X7220

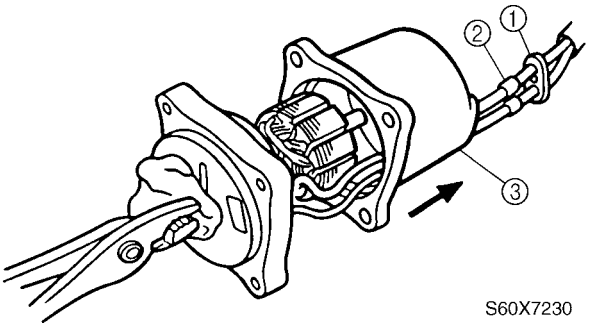
CAUTION:
- **Make sure that the trim and tilt rams are fully extended when removing the power trim and tilt motor, otherwise fluid can spurt out from the unit due to internal pressure.**
- **Do not push the trim and tilt rams down while the power trim and tilt motor is removed from the power trim and tilt unit, otherwise fluid can spurt out.**

2. Check the gear pump filter for dirt or residue and for damage. Clean or replace if necessary.

7

3. Remove the lead holder ① and rubber spacers ② from the stator, and then slide them away from the stator.

4. Remove the stator ③.



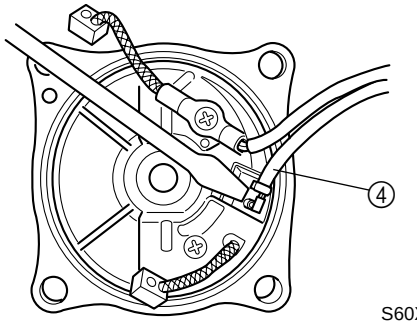
S60X7230

NOTE:
Place a clean cloth over the end of the armature shaft, hold it with a pair of pliers, and then carefully slide the stator off of the armature.

5. Remove the armature from the PTT motor base.

CAUTION:
Do not allow grease or oil to contact the commutator.

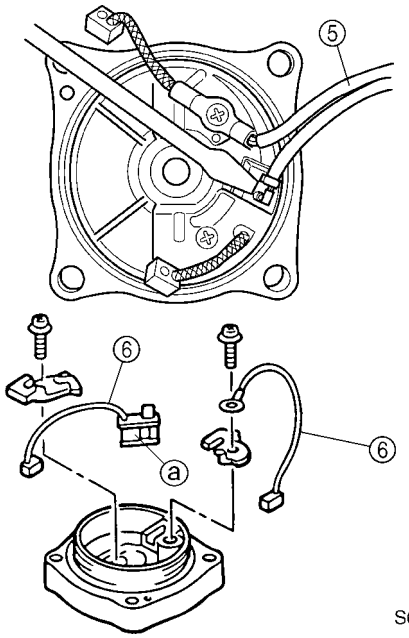
6. Disconnect the PTT motor lead (sky blue) ④.



S60X7240

NOTE:
Hold the brush with a screwdriver as shown, and then disconnect the PTT motor lead (sky blue).

7. Remove the screw, disconnect the PTT motor lead (light green) ⑤, and then remove the brushes ⑥.

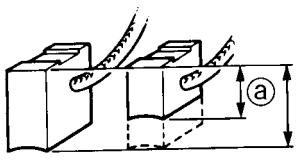


S60X7250

CAUTION:
- **Do not pull the PTT motor leads out from the stator.**
- **Do not touch the bimetal ⓐ, otherwise the operation of the circuit breaker can be affected.**

Checking the power trim and tilt motor

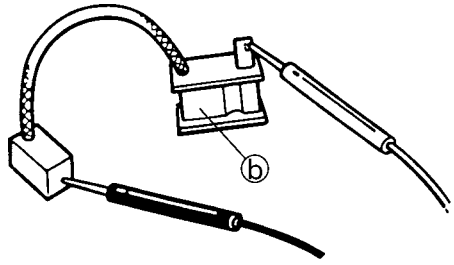
1. Measure the length of the brushes. Replace if out of specification.



S60X7260

Brush length limit ⓐ:
4.8 mm (0.19 in)

2. Check the brush and circuit breaker for continuity. Replace if there is no continuity.

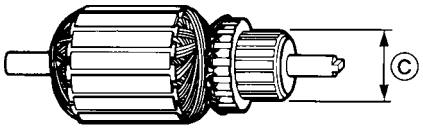


S60X7270

CAUTION:

Do not touch the bimetal ⓑ, otherwise the operation of the circuit breaker can be affected.

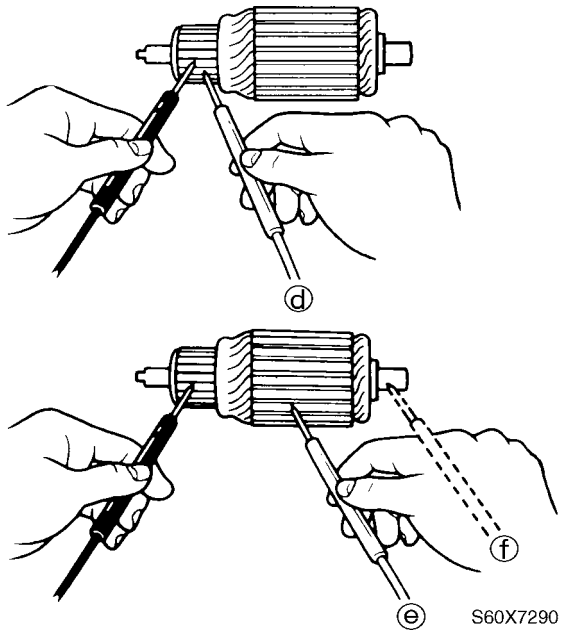
3. Measure the commutator diameter. Replace if out of specification.



S60X7280

Commutator diameter limit ⓒ:
21.0 mm (0.83 in)

4. Check the armature for continuity. Replace if out of specifications.



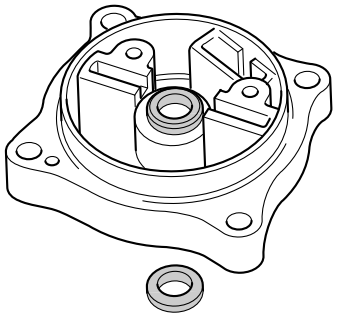
S60X7290

Armature continuity

Commutator segments ⓓ	Continuity
Segment ⓓ – Armature core ⓔ	No continuity
Segment ⓓ – Armature shaft ⓕ	No continuity

5. Check the base for cracks or damage. Replace if necessary.

6. Check the bearing and oil seal for damage or wear. Replace if necessary.



S60X7300

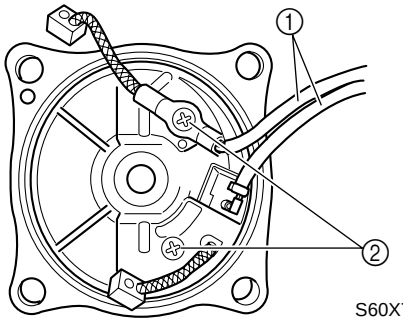
NOTE:

If the bearing and oil seal are removed, always replace them with new ones.

7

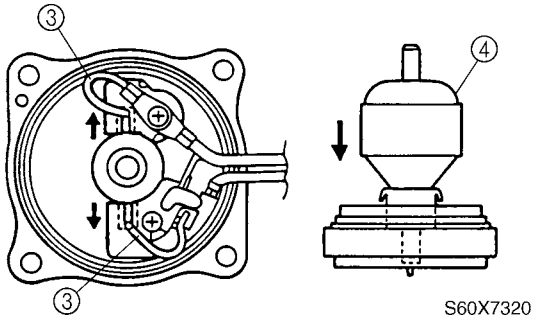
Assembling the power trim and tilt motor

1. Connect the PTT motor leads ①, and then tighten the screws ②.



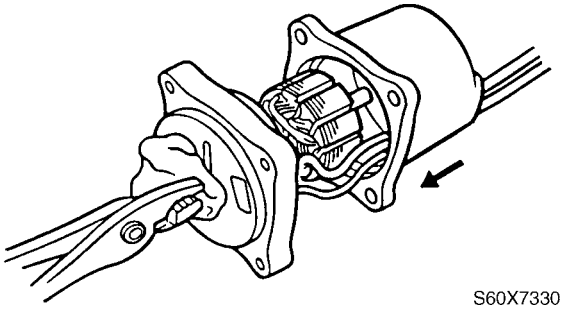
S60X7310

2. Push the brushes ③ into the brush holder, and then install the armature ④.



S60X7320

3. Install the stator onto the base.

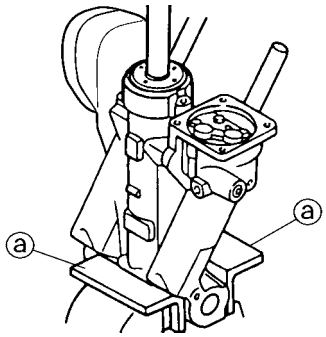

S60X7330

NOTE:

Place a clean cloth over the end of the armature shaft, hold it with a pair of pliers, and then carefully slide the stator over the armature.

Removing the reservoir

1. Hold the power trim and tilt unit in a vise using aluminum plates ⓐ on both sides.



S60X7390

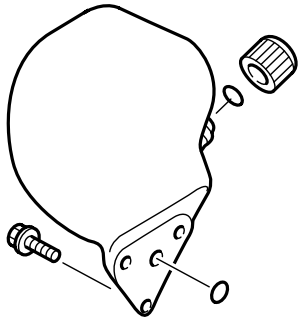
CAUTION:

Do not use rags or paper to clean the hydraulic system components. Small pieces of fibers remaining on them can cause the system to malfunction.

NOTE:

Place a container under the power trim and tilt unit to catch the fluid.

2. Remove the reservoir and O-rings.


S60X7400

CAUTION:

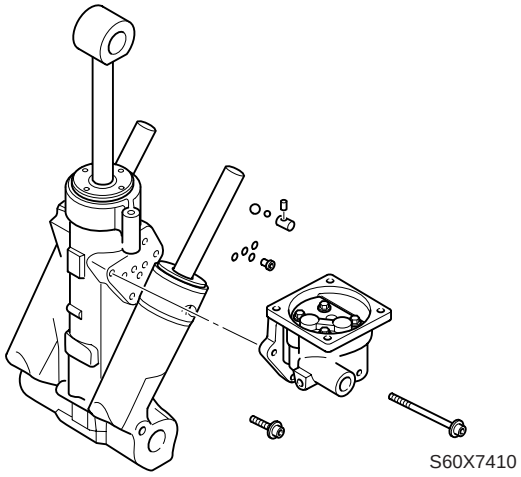
- **Make sure that the trim and tilt rams are fully extended when removing the reservoir, otherwise fluid can spurt out from the unit due to internal pressure.**
- **Do not push the tilt and trim rams down while the power trim and tilt motor is removed from the power trim and tilt unit, otherwise fluid can spurt out.**

3. Drain the fluid from the reservoir and check it for damage. Replace if necessary.

4. Check the reservoir cap and O-ring for damage. Replace if necessary.

Disassembling the gear pump housing

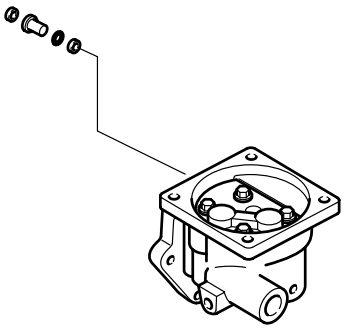
1. Remove the gear pump housing.



S60X7410

NOTE:
Make sure that the O-rings, valve pin, and valve seat assembly are removed.

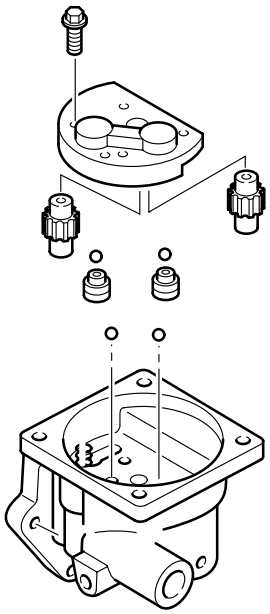
2. Remove the filters, down-relief valve, and O-ring from the gear pump housing.



S60X7420

NOTE:
Remove the back filter using compressed air, being careful not to blow the filter out abruptly.

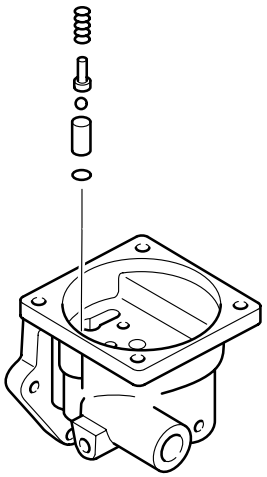
3. Remove the gear pump cover and drive gears.



S60X7430

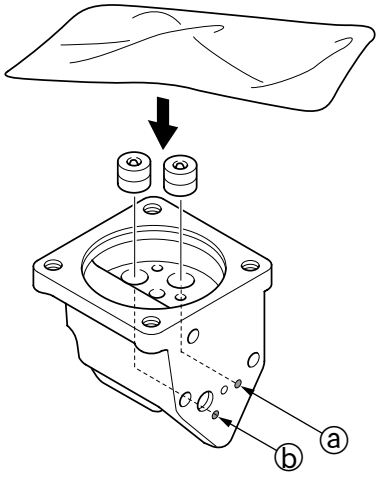
NOTE:
Make sure that the shuttle pistons and balls are removed, since they tend to stick to the gear pump cover.

4. Remove the up-relief valve assembly.



S60X7440

5. Remove the main valves.



S60X7450

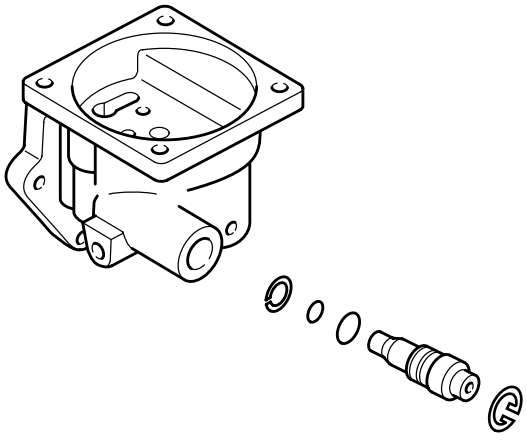
⚠ WARNING

Never look into the pump housing opening while removing the main valves because the main valves and power trim and tilt fluid can be forcefully expelled out.

NOTE:

To remove the main valves, cover the pump housing with a clean cloth, and then blow compressed air through holes ⓐ and ⓑ while holding the cloth down.

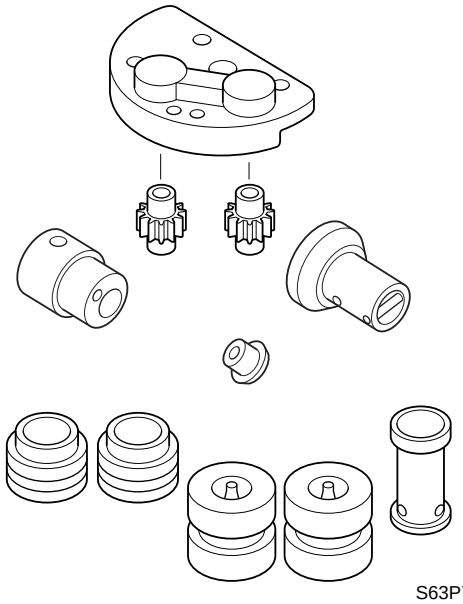
6. Remove the manual valve.


S60X7460

Checking the gear pump

1. Clean all the valves, pistons, and balls, and then check them for damage or wear. Check the filters for damage or clogs. Replace if necessary.

2. Check the drive gears for damage or wear. Replace the gear pump assembly if necessary.

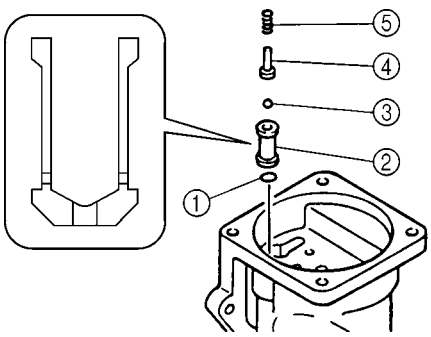

S63P7010

Assembling the gear pump housing

CAUTION:

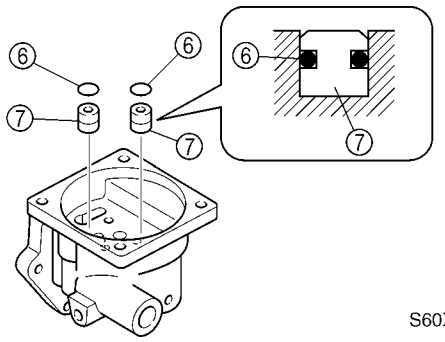
Install the components and parts in their original direction and positions.

1. Install a new O-ring ①, the up-relief valve seat ②, ball ③, absorber valve pin ④, and spring ⑤ into the gear pump housing.



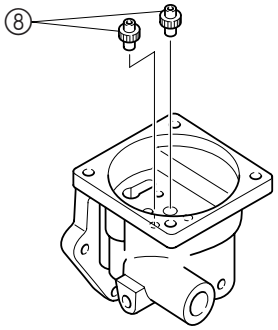
S60X7480

2. Install new O-rings ⑥ onto the main valves ⑦, and then install the main valves into the gear pump housing.



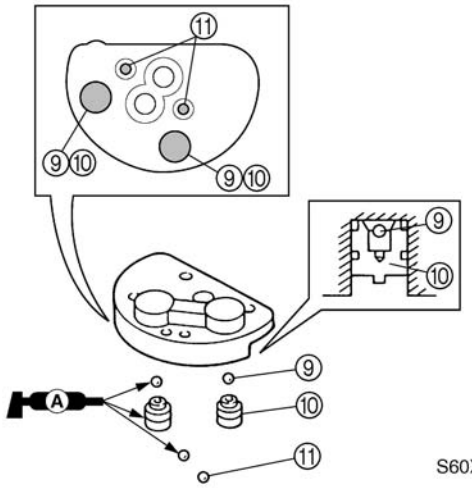
S60X7490

3. Install the drive gears ⑧ into the gear pump housing.



S60X7500

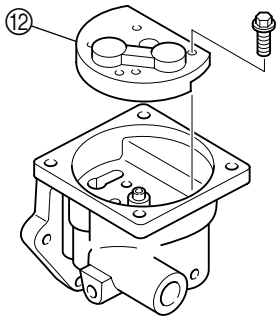
4. Install the balls ⑨, shuttle pistons ⑩, and balls ⑪ into the gear pump cover.



S60X7510

NOTE:
Apply grease to the balls and shuttle pistons to prevent them from falling out of the gear pump cover.

5. Install the gear pump cover ⑫ into the gear pump housing, and then tighten the bolts.



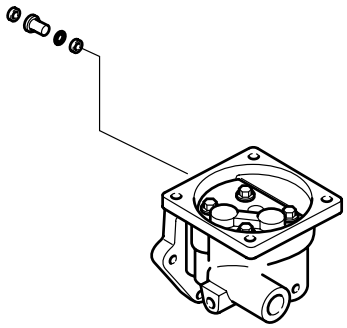
S60X7520

6. Check that the gear pump turns smoothly, and then tighten the gear pump cover bolts to the specified torque.

	Gear pump cover bolt: 6 N·m (0.6 kgf·m, 4.4 ft·lb)

7. Install a new O-ring onto the down-relief valve.

8. Install the filter, down-relief valve, and filter into the gear pump housing.


S60X7530

9. Install a new O-ring onto the manual valve.

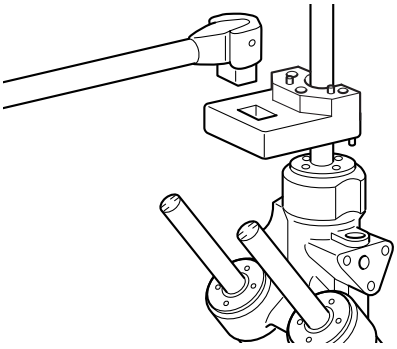
10. Install the manual valve and circlip into the gear pump housing.

	Manual valve: 3 N·m (0.3 kgf·m, 2.2 ft·lb)

7

Disassembling the tilt cylinder and trim cylinder

1. Loosen the tilt cylinder end screw, and then remove the tilt piston assembly.


S63P7020

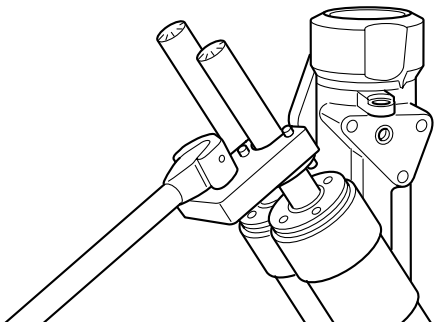
CAUTION:

Make sure that the trim and tilt rams are fully extended before removing the tilt cylinder end screw.

Trim and tilt wrench:
New: 90890-06587
Current: 90890-06548

2. Drain the fluid.

3. Loosen the trim cylinder end screws, and then remove the trim piston assemblies.

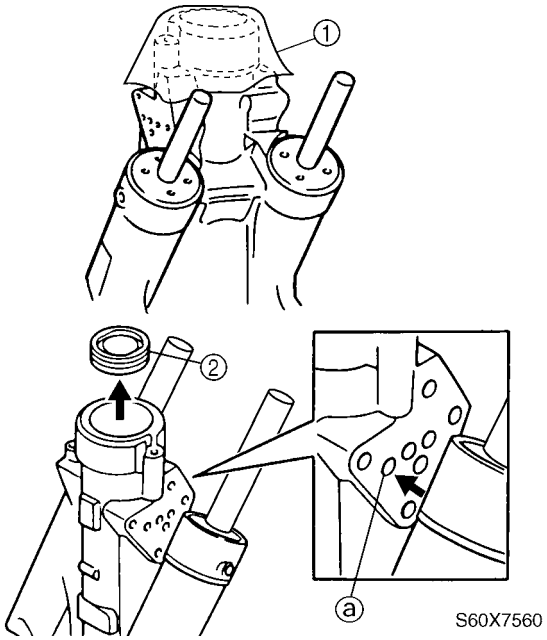

S63P7030

Trim and tilt wrench:
New: 90890-06587
Current: 90890-06548

4. Drain the fluid.

5. Install the trim piston assemblies, and then tighten the trim cylinder end screws finger tight.

6. Cover the tilt cylinder opening with a clean cloth ①, and then blow compressed air through the hole ⓐ to remove the free piston ②.



S60X7560

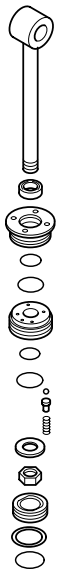
⚠ WARNING

Never look into the tilt cylinder opening while removing the free piston because the free piston and power trim and tilt fluid can be forcefully expelled out.

7. Loosen the trim cylinder end screws, and then remove the trim piston assemblies.

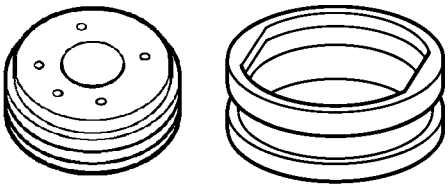
Checking the tilt cylinder and trim cylinder

1. Disassemble the tilt piston assembly.



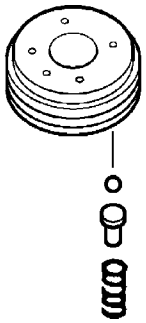
S60X7570

2. Check the tilt piston and free piston for scratches. Replace if necessary.



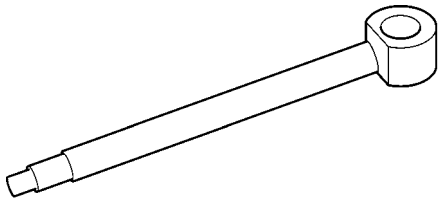
S60X7580

3. Blow the tilt piston absorber valve with compressed air to remove any foreign material. Check the valve for wear and the spring for deterioration. Replace if necessary.



S60X7590

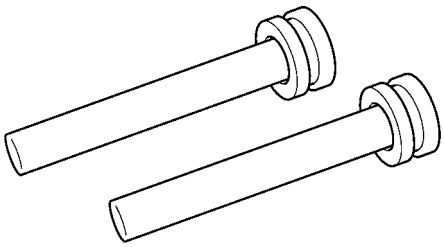
4. Check the tilt ram for bends or excessive corrosion. Polish with 400- to 600-grit sandpaper if there is light rust or replace if necessary.



S60X7600

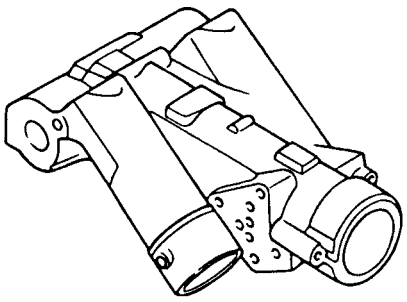
5. Check the trim pistons for scratches. Replace if necessary.

6. Check the trim rams for bends or excessive corrosion. Polish with 400- to 600-grit sandpaper if there is light rust or replace if necessary.



S60X7610

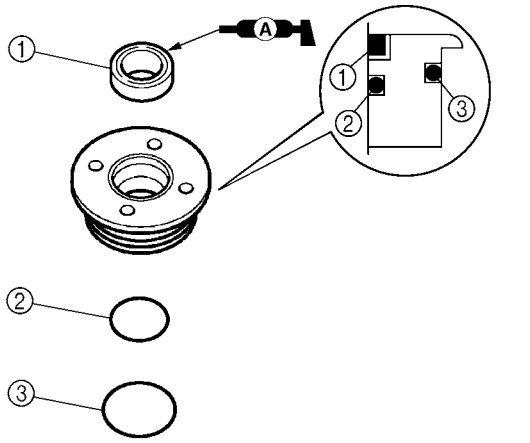
7. Check the inner walls of the trim and tilt cylinders for scratches. Replace if necessary.



S60X7620

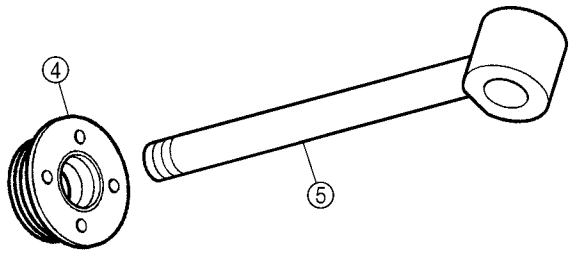
Assembling the tilt piston and trim pistons

1. Install the new dust seal ① and new O-rings ② and ③ onto the tilt cylinder end screw.



S60X7630

2. Install the tilt cylinder end screw ④ onto the tilt ram ⑤.

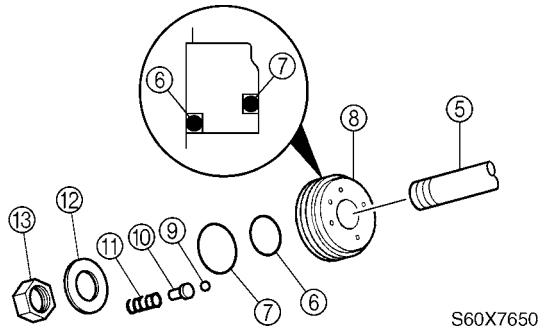


S60X7640

3. Install new O-rings ⑥ and ⑦ onto the tilt piston ⑧.

4. Install the ball ⑨, valve ⑩, and spring ⑪, in this order.

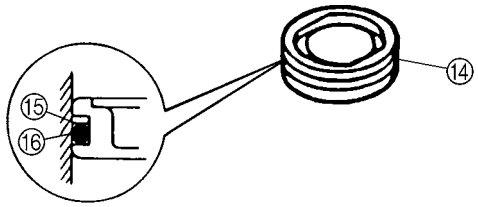
5. Install the tilt piston assembly and washer ⑫ onto the tilt ram ⑤, and then tighten the tilt piston nut ⑬ to the specified torque.



S60X7650

	Tilt piston nut: 96 N·m (9.6 kgf·m, 70.8 ft·lb)

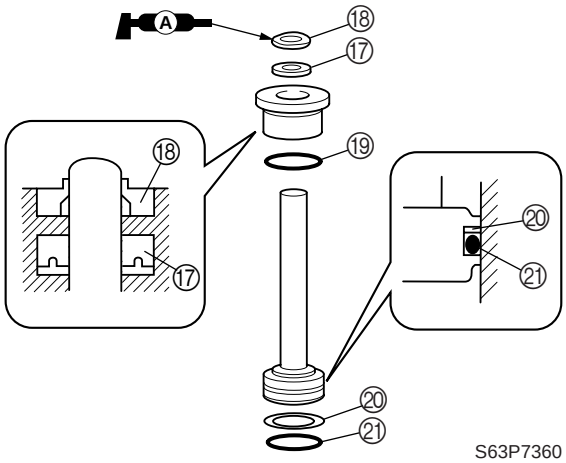
6. Install a new backup ring ⑮ and a new O-ring ⑯ onto the free piston ⑭.



S60X7660

7. Install a new oil seal ⑰, a new dust seal ⑱, and a new O-ring ⑲ onto each trim cylinder end screw.

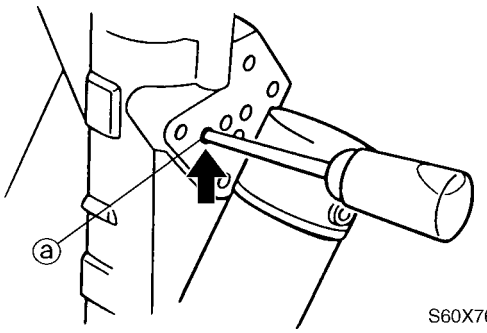
8. Install the backup ring ⑳ and a new O-ring ㉑ onto each trim piston.



S63P7360

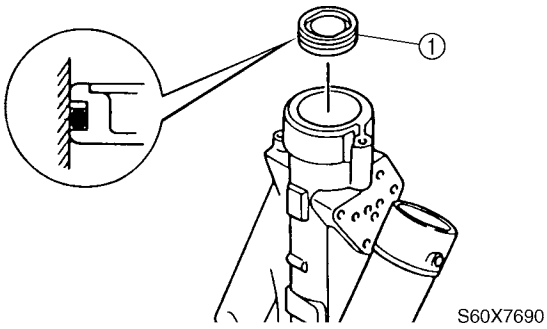
Assembling the power trim and tilt unit

1. Fill the tilt cylinder with the specified amount of the recommended fluid through the hole ⓐ.

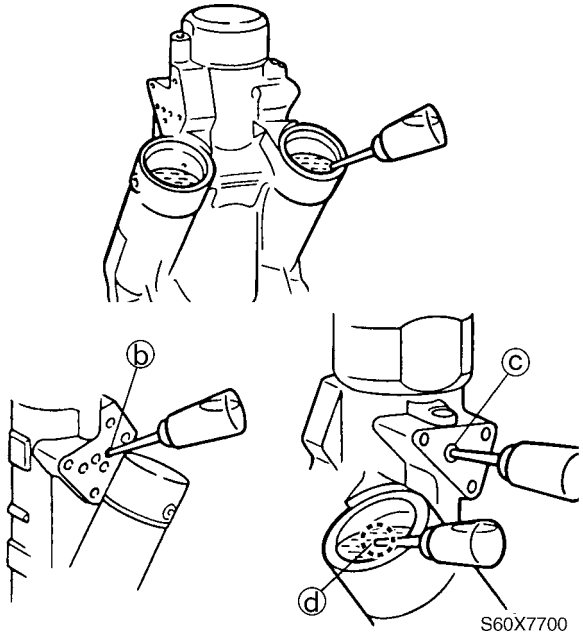


Recommended power trim and tilt fluid:
ATF Dexron II
Fluid quantity:
30 cm^3 (1.0 US oz, 1.1 Imp oz)

2. Push the free piston ① into the tilt cylinder until it bottoms out.



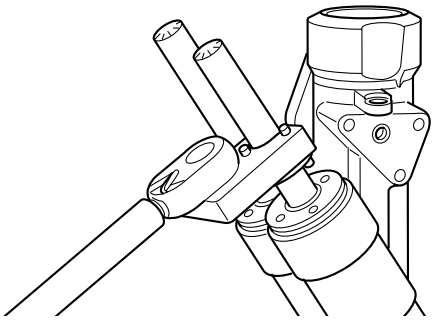
3. Fill the trim cylinders with the recommended fluid to the correct level through holes ⓑ and ⓒ, and ⓓ as shown.



Recommended power trim and tilt fluid:
ATF Dexron II

7

4. Install the trim piston assemblies into the trim cylinders, and then tighten the trim cylinder end screws to the specified torque.

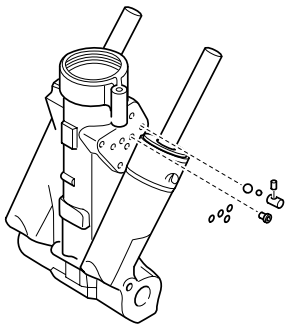

S63P7040

CAUTION:
- **Make sure that the trim rams are fully extended when installing them.**
- **Once installed, never push the trim rams down, otherwise fluid can spurt out.**

Trim and tilt wrench:
New: 90890-06587
Current: 90890-06548

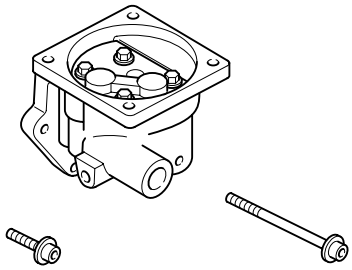
Trim cylinder end screw:
78 N·m (7.8 kgf·m, 57.5 ft·lb)

5. Install new O-rings, the valve pin, and valve seat assembly onto the tilt cylinder.


S60X7720

NOTE:
Refer to the illustration for valve pin and valve seat assembly installation.

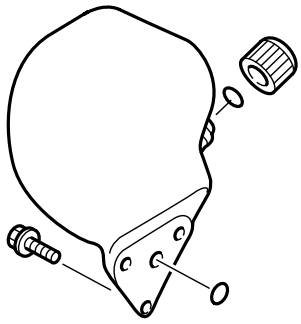
6. Install the gear pump housing.


S60X7730

Gear pump housing mounting bolt:
8 N·m (0.8 kgf·m, 5.9 ft·lb)

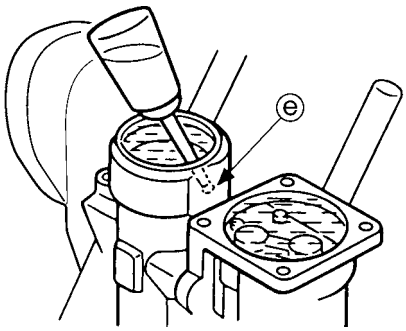
7. Install the O-ring into the reservoir cap.

8. Install the reservoir and O-ring onto the gear pump housing.


S60X7400

Reservoir mounting bolt:
5 N·m (0.5 kgf·m, 3.7 ft·lb)

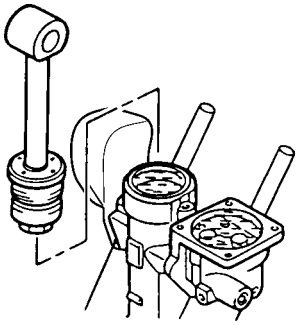
9. Fill the tilt cylinder with the recommended fluid to the correct level through the hole ⓔ as shown.

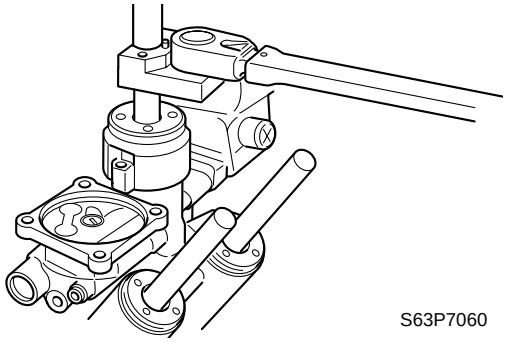


S60X7740

Recommended power trim and tilt fluid:
ATF Dexron II

10. Install the tilt piston assembly into the tilt cylinder, and then tighten the tilt cylinder end screw to the specified torque.


S60X7750


S63P7060

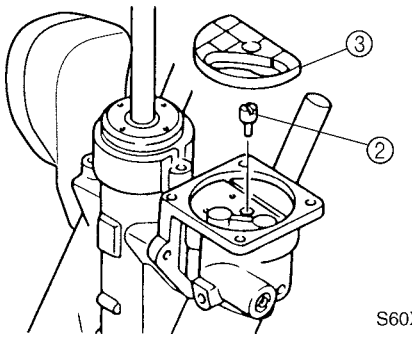
CAUTION:

- **Make sure that the tilt ram is fully extended when installing it.**
- **Once installed, never push the tilt ram down, otherwise fluid can spurt out.**

Trim and tilt wrench:
New: 90890-06587
Current: 90890-06548

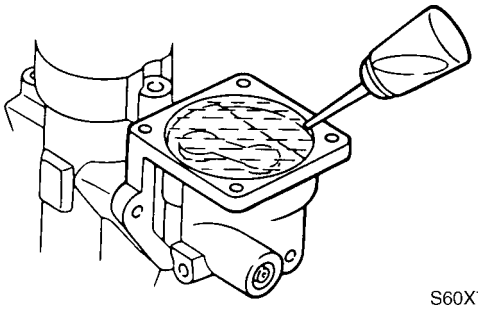
Tilt cylinder end screw:
130 N·m (13.0 kgf·m, 96.0 ft·lb)

11. Install the joint ② and gear pump filter ③ into the gear pump housing.



S60X7760

12. Fill the gear pump housing with the recommended fluid to the correct level as shown.

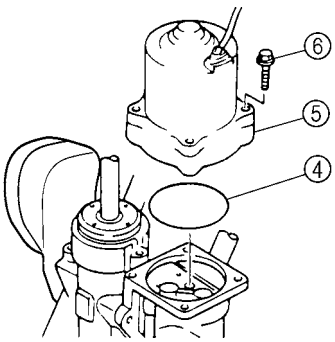

S60X7770

Recommended power trim and tilt fluid:
ATF Dexron II

13. Remove all of the air bubble using a syringe or suitable tool.

NOTE:
Turn the joint with a screwdriver to bleed the gear pump.

14. Install a new O-ring ④ and the power trim and tilt motor ⑤, and then tighten the bolts ⑥ to the specified torque.



S60X7780

NOTE:
Align the armature shaft with the recess in the joint.

PTT motor mounting bolt:
5 N·m (0.5 kgf·m, 3.7 ft·lb)

7

15. Remove the reservoir cap, and then check the fluid level in the reservoir.

NOTE:
If the fluid is at the correct level, the fluid should overflow out of the filler hole when the reservoir cap is removed.

16. If necessary, add sufficient fluid of the recommended type until it overflows out of the filler hole.

Recommended power trim and tilt fluid:
ATF Dexron II

17. Install the reservoir cap, and then tighten it to the specified torque.

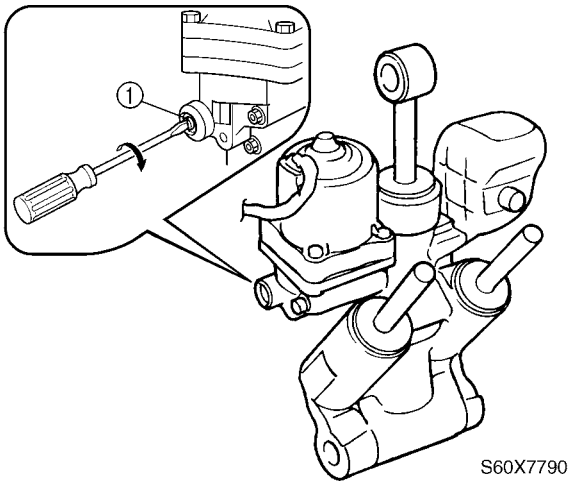
Reservoir cap:
0.7 N·m (0.07 kgf·m, 0.5 ft·lb)

18. Bleed the power trim and tilt unit.

19. Check the hydraulic pressure of the power trim and tilt unit.

Bleeding the power trim and tilt unit

1. Tighten the manual valve ① by turning it clockwise.



2. Place the power trim and tilt unit in an upright position.

3. Remove the reservoir cap, and then check the fluid level in the reservoir.

NOTE:
If the fluid is at the correct level, the fluid should overflow out of the filler hole when the reservoir cap is removed.

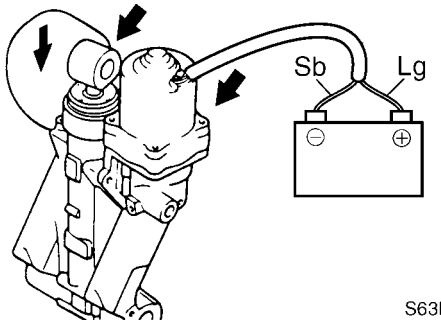
4. If necessary, add sufficient fluid of the recommended type until it overflows out of the filler hole.

Recommended power trim and tilt fluid:
ATF Dexron II

5. Install the reservoir cap, and then tighten it to the specified torque.

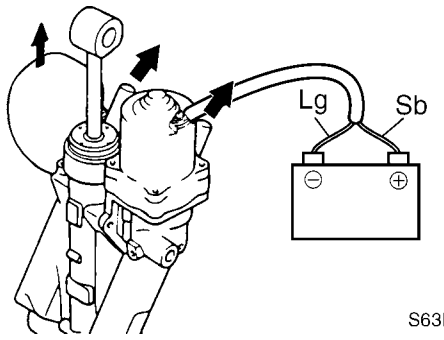
Reservoir cap:
0.7 N·m (0.07 kgf·m, 0.5 ft·lb)

6. Connect the PTT motor leads to the battery terminals to fully retract the trim and tilt rams.



Rams	PTT motor lead	Battery terminal
Down	Light green (Lg)	⊕
	Sky blue (Sb)	⊖

7. Reverse the PTT motor leads between the battery terminals to fully extend the trim and tilt rams.



S63P7340

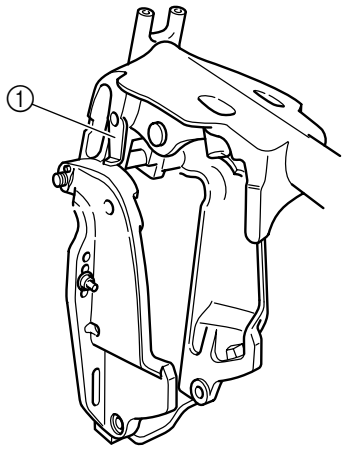
Rams	PTT motor lead	Battery terminal
Up	Sky blue (Sb)	⊕
	Light green (Lg)	⊖

NOTE:
- Repeat this procedure so that the rams go up and down four or five times (be sure to wait a few seconds before switching the leads).
- If the rams do not move up and down easily, push and pull on the rams to assist operation.

8. Check the fluid level when the tilt ram is fully extended. Add sufficient fluid if necessary.

Installing the power trim and tilt unit

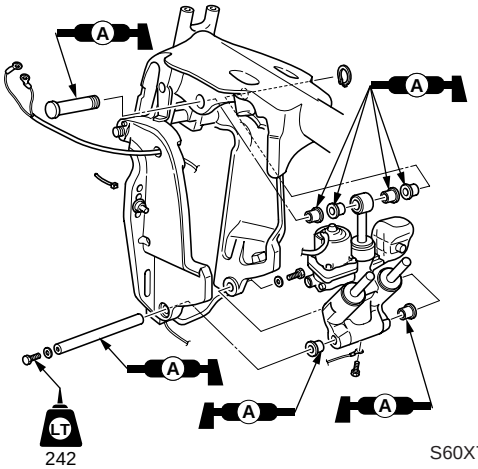
1. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.



S60X7820

CAUTION:
After tilting the outboard motor up, be sure to support it with the tilt stop lever.

2. Install the collars.
3. Lift the power trim and tilt unit up, and then install the upper mounting shaft.
4. Install the circlip.
5. Install the lower mounting shaft, and then tighten the bolts.
6. Install the plastic ties, route the PTT motor leads through the hole, and then install the plastic ties.
7. Connect the ground lead to the bottom of the power trim and tilt unit, and then tighten the bolt.

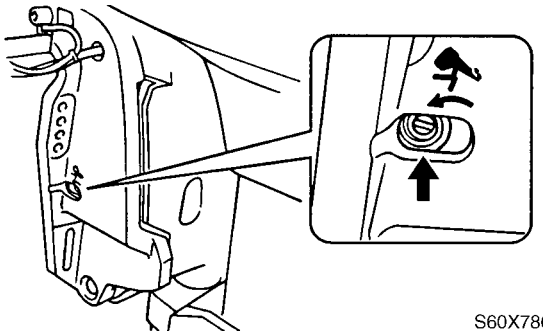


242
S60X7130

7

Bleeding the power trim and tilt unit (built-in)

1. Fully turn the manual valve counterclockwise.


S60X7860

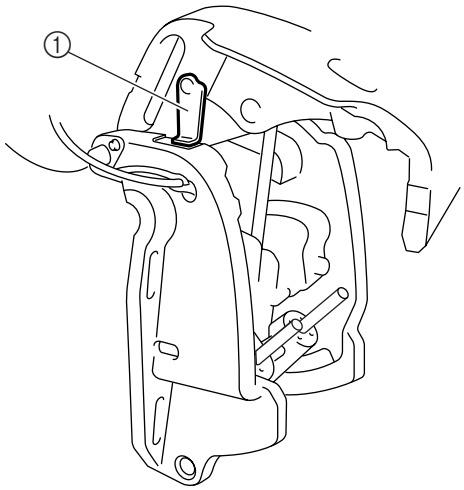
2. Fully tilt the outboard motor up, and then release it to let it lower by its own weight four to five times.

3. Tighten the manual valve by turning it clockwise.

4. Let the fluid settle for 5 minutes.

5. Push and hold the power trim and tilt switch in the up position to check that the outboard motor is fully tilted up.

6. Support the outboard motor with the tilt stop lever ①.

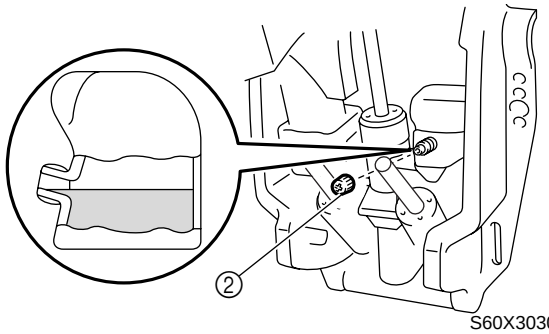


S60X3020

⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

7. Remove the reservoir cap ②, and then check the fluid level in the reservoir.



S60X3030

NOTE:

If the fluid is at the correct level, the fluid should overflow out of the filler hole when the reservoir cap is removed.

8. If necessary, add sufficient fluid of the recommended type to the correct level.

Recommended power trim and tilt fluid:
ATF Dexron II

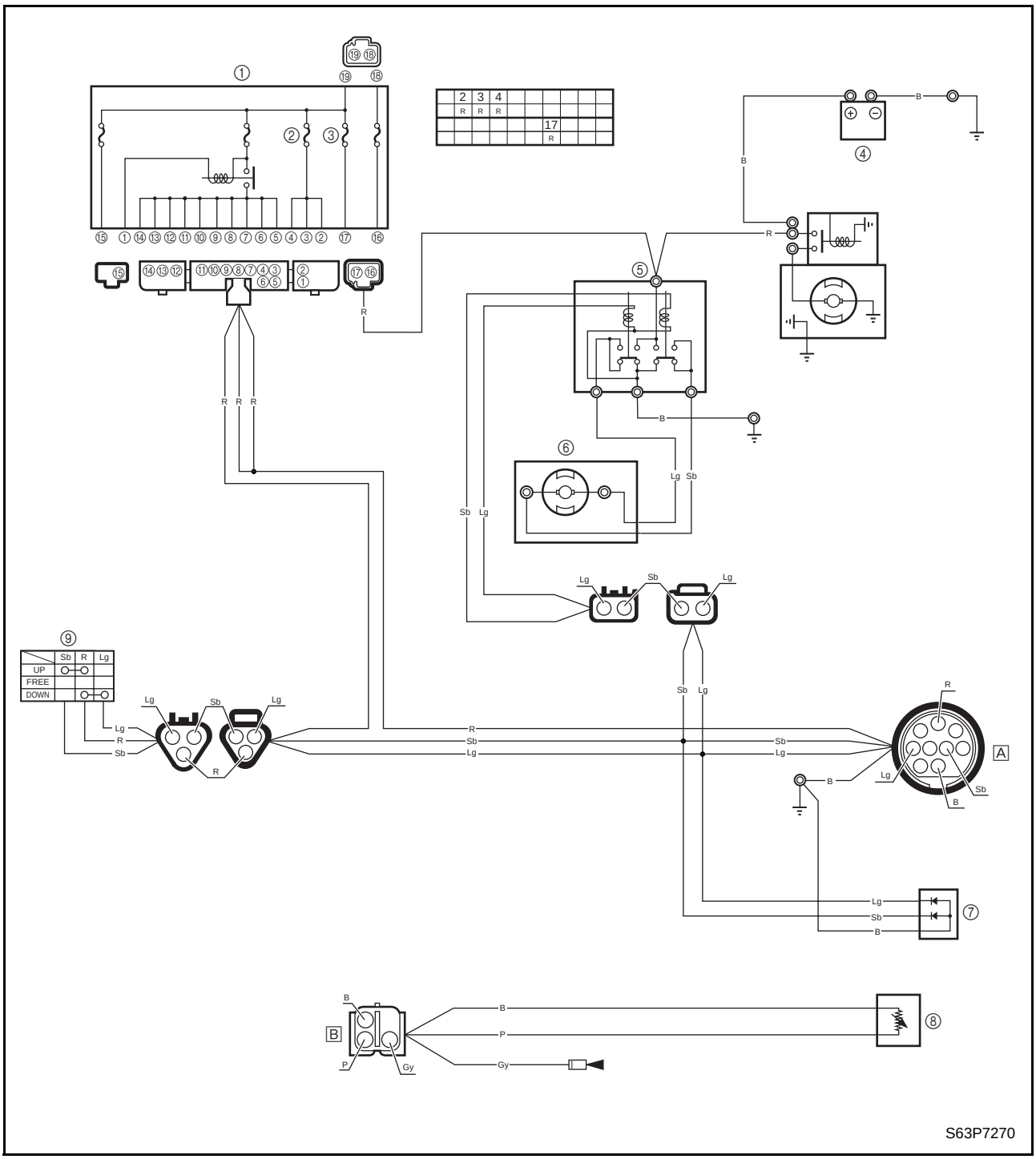
9. Install the reservoir cap, and then tighten it to the specified torque.

Reservoir cap:
0.7 N·m (0.07 kgf·m, 0.5 ft·lb)

NOTE:

Repeat this procedure until the fluid remains at the correct level.

Power trim and tilt electrical system



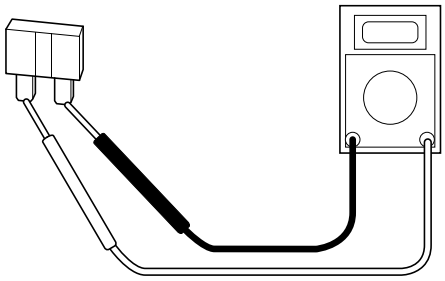
① Fuse holder
② Fuse (20 A)
③ Fuse (50 A)
④ Battery
⑤ Power trim and tilt relay
⑥ Power trim and tilt motor
⑦ Diode
⑧ Trim sensor
⑨ Power trim and tilt switch

A To remote control box/switch panel
B To trim meter

B : Black
Gy : Gray
Lg : Light green
P : Pink
R : Red
Sb : Sky blue

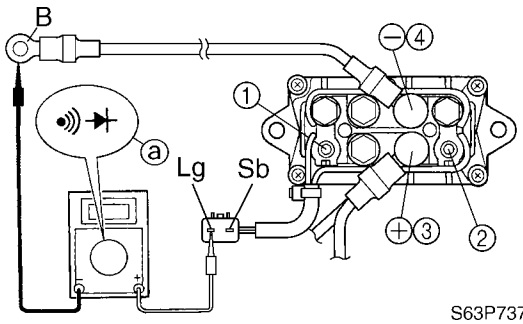
Checking the fuse

1. Check the fuse for continuity. Replace if there is no continuity.


S69J7525

Checking the power trim and tilt relay

1. Check the power trim and tilt relay for continuity. Replace if out of specification.

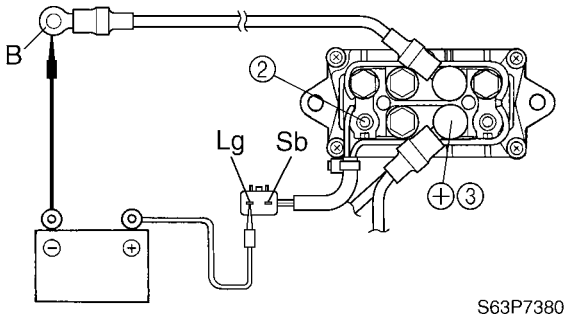


S63P7370

NOTE:
Be sure to set the measurement range ⓐ shown in the illustration when checking for continuity.

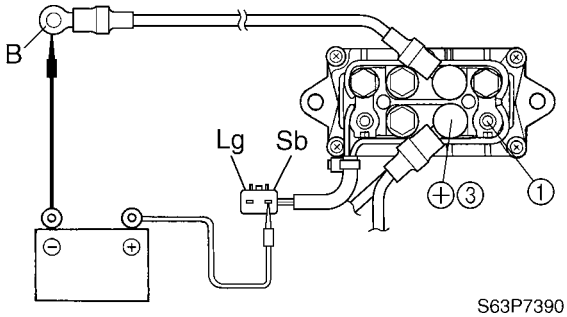
Power trim and tilt relay continuity	
Sky blue (Sb) – Black (B) Light green (Lg) – Black (B)	Continuity
Terminal ① – Terminal ④ Terminal ② – Terminal ④	Continuity
Terminal ① – Terminal ③ Terminal ② – Terminal ③	No continuity

2. Connect the digital circuit tester between power trim and tilt relay terminals ② and ③.
3. Connect the light green (Lg) lead to the positive battery terminal and the black (B) lead to the negative battery terminal as shown.
4. Check for continuity between terminals ② and ③. Replace if there is no continuity.



S63P7380

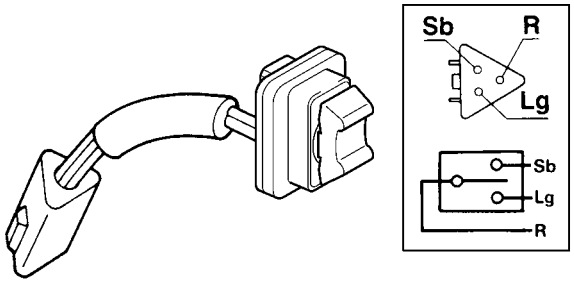
5. Connect the digital circuit tester between power trim and tilt relay terminals ① and ③.
6. Connect the sky blue (Sb) lead to the positive battery terminal and the black (B) lead to the negative battery terminal as shown.
7. Check for continuity between terminals ① and ③. Replace if there is no continuity.



S63P7390

Checking the power trim and tilt switch

1. Check the power trim and tilt switch for continuity. Replace if out of specification.

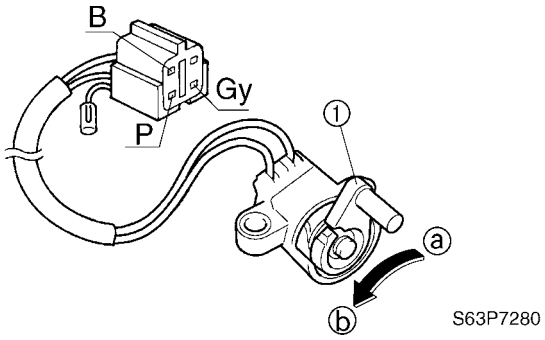


S60V7730

	Lead color		
Switch position	Sky blue (Sb)	Red (R)	Lightgreen (Lg)
Up	○——○		
Free			
Down		○——○	

Checking the trim sensor

1. Measure the trim sensor resistance. Replace if out of specification.



S63P7280

NOTE:
Turn the lever ① and measure the resistance as it gradually changes.

Trim sensor resistance:
Pink (P) – Black (B)
238.8–378.8 Ω at 20 °C (68 °F) ⓐ
9–11 Ω at 20 °C (68 °F) ⓑ

7

— MEMO —

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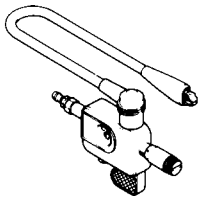
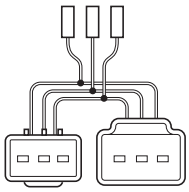
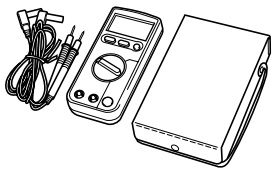
Special service tools



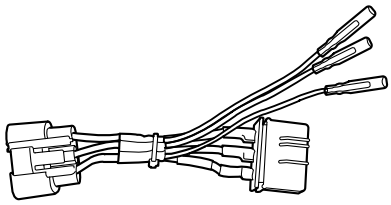
Ignition tester
90890-06754



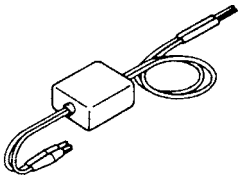
Test harness (3 pins)
90890-06793



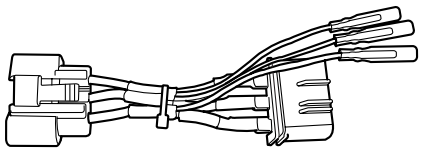
Digital circuit tester
90890-03174



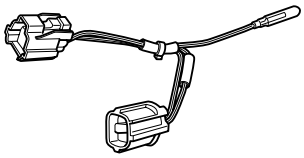
Test harness (3 pins)
90890-06847



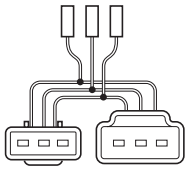
Peak voltage adapter B
90890-03172



Test harness (3 pins)
90890-06846



Test harness (2 pins)
90890-06792



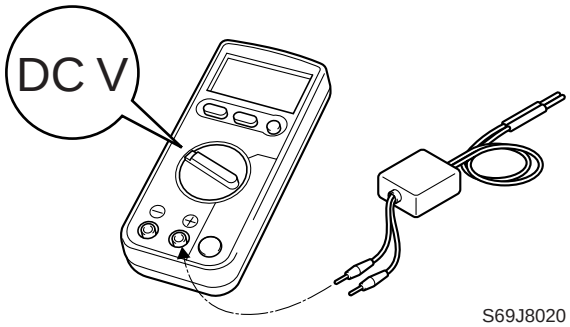
Test harness (3 pins)
90890-06791

Checking the electrical components

Measuring the peak voltage

NOTE:
Before troubleshooting the peak voltage, check that all electrical connections are tight and free from corrosion, and that the battery is fully charged to 12 V.

The condition of the ignition system can be determined by measuring the peak voltage. Cranking speed is effected by many factors, such as fouled or weak spark plugs, or a weak battery. If one of these factors is present, the peak voltage will be lower than specification. In addition, if the peak voltage is lower than specification the engine will not operate properly.



S69J8020

⚠ WARNING

When checking the peak voltage, do not touch any of the connections of the digital tester leads.

NOTE:
- Use the peak voltage adapter with the digital circuit tester.
- When measuring the peak voltage, set the selector on the digital circuit tester to the **DC voltage mode**.
- Connect the positive pin on the peak voltage adapter to the positive terminal of the digital circuit tester.

Measuring the lower resistance

When measuring a resistance of 10 Ω or less with the digital circuit tester, the correct measurement cannot be obtained due to the internal resistance of the tester. To obtain the correct value, subtract the internal resistance from the displayed measurement.

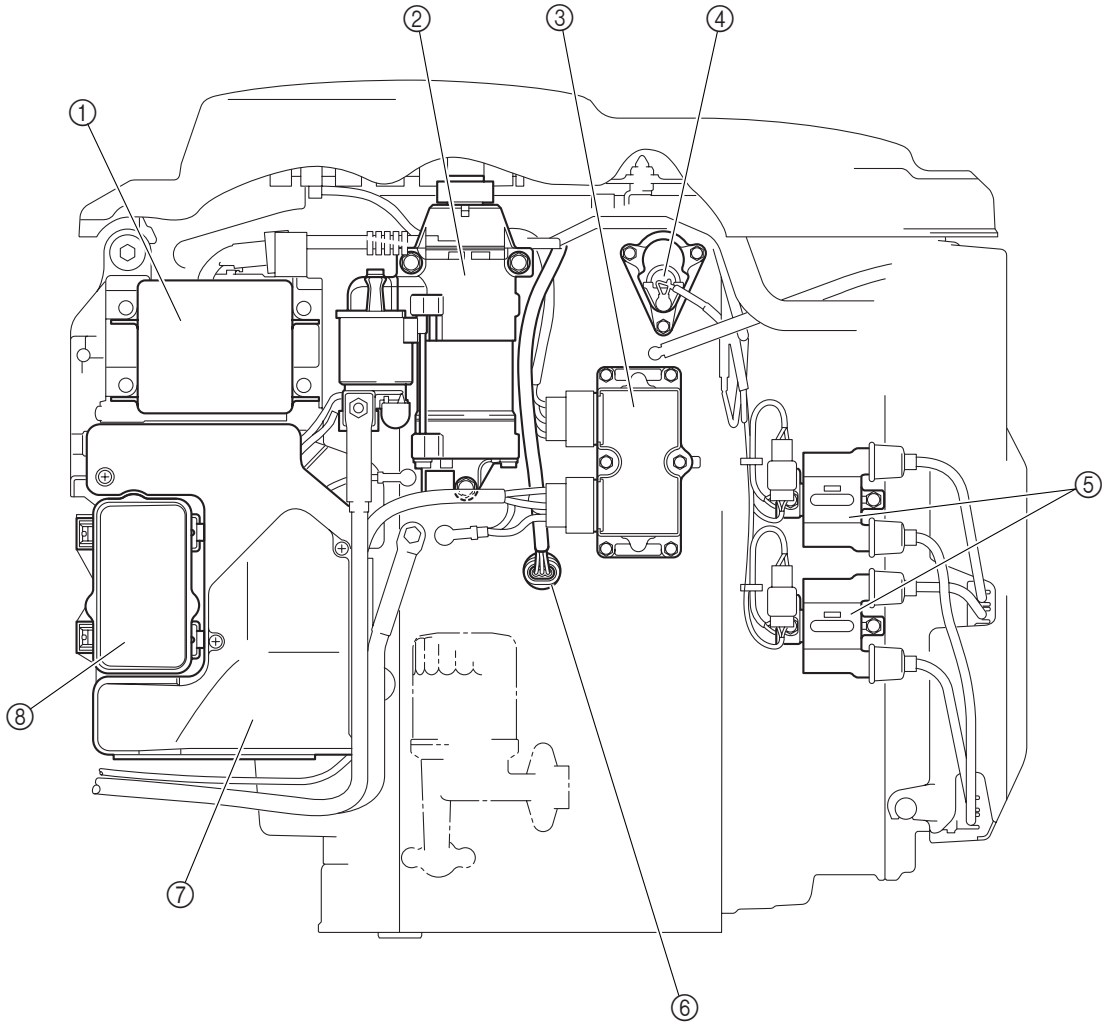
NOTE:
To obtain the internal resistance of the digital circuit tester, connect both of its probes and check the display.

Correct value =
displayed measurement – internal resistance

8

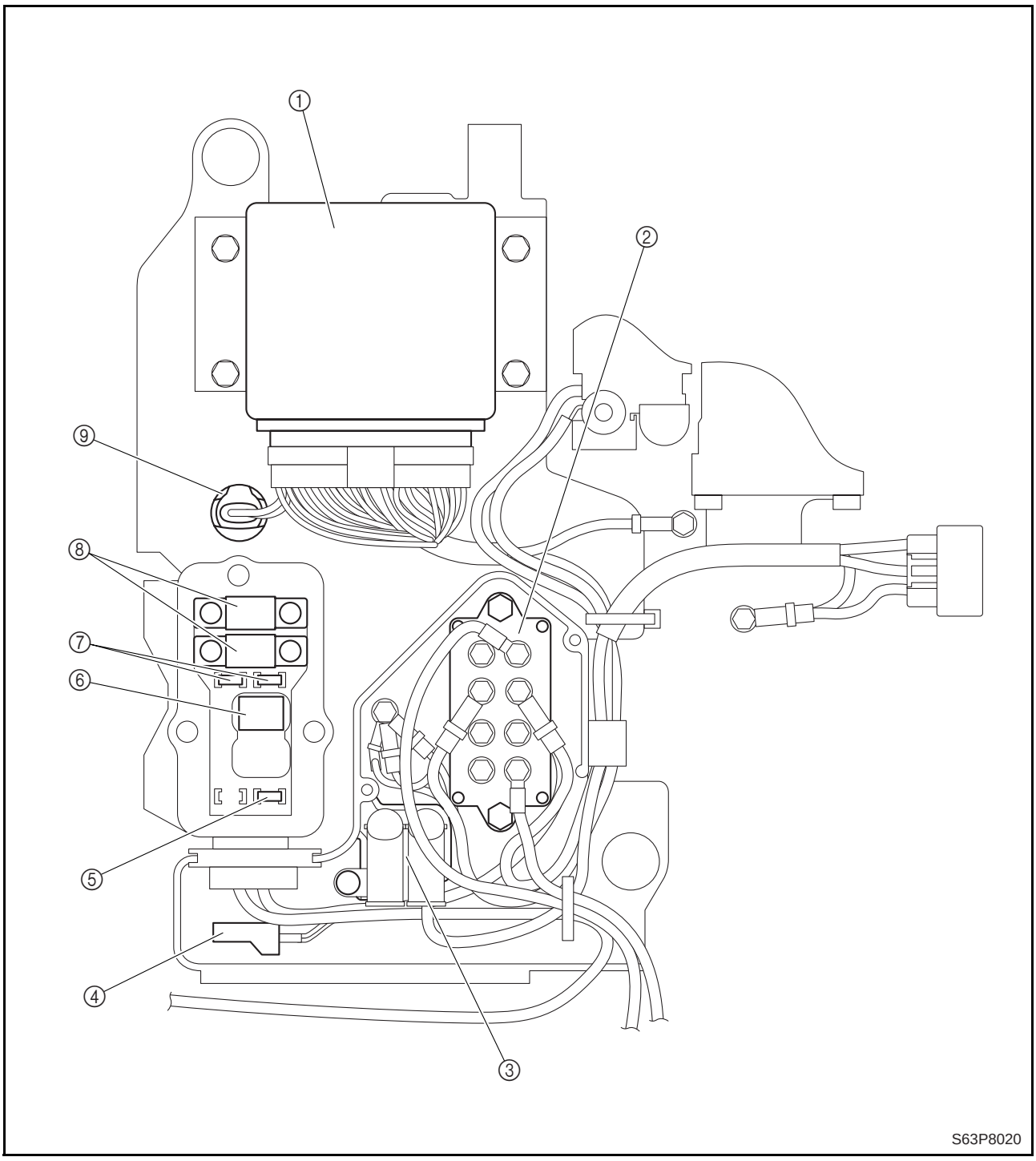
Electrical components

Port view



① ECM
② Starter motor
③ Rectifier Regulator
④ Thermoswitch
⑤ Ignition coil
⑥ Oil pressure sensor
⑦ Junction box
⑧ Fuse holder

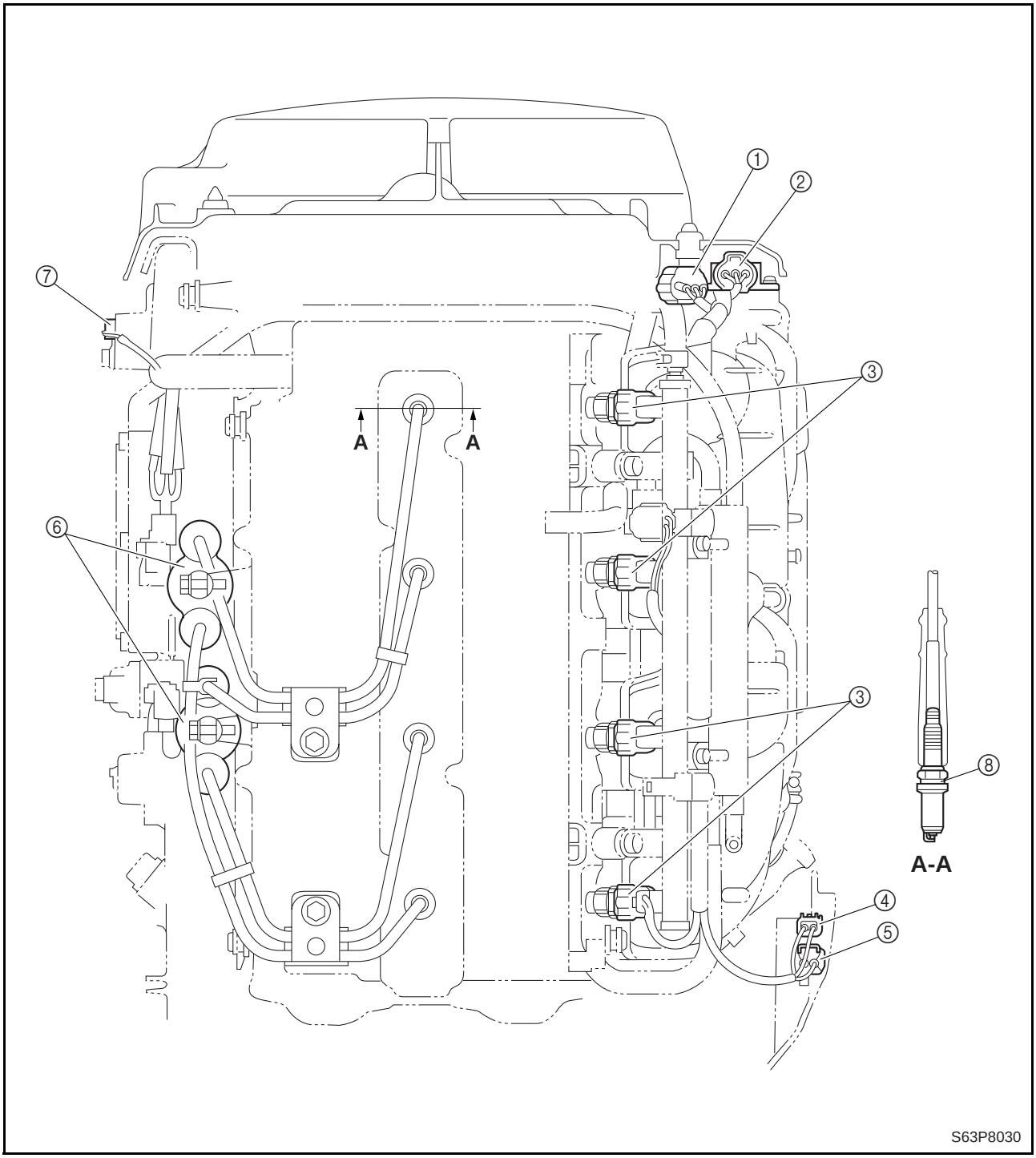
Junction box assembly



① ECM
② Power trim and tilt relay
③ Starter relay
④ Diode
⑤ Fuse (30 A)
⑥ Main relay
⑦ Fuse (20 A)
⑧ Fuse (50 A)
⑨ Intake air temperature sensor

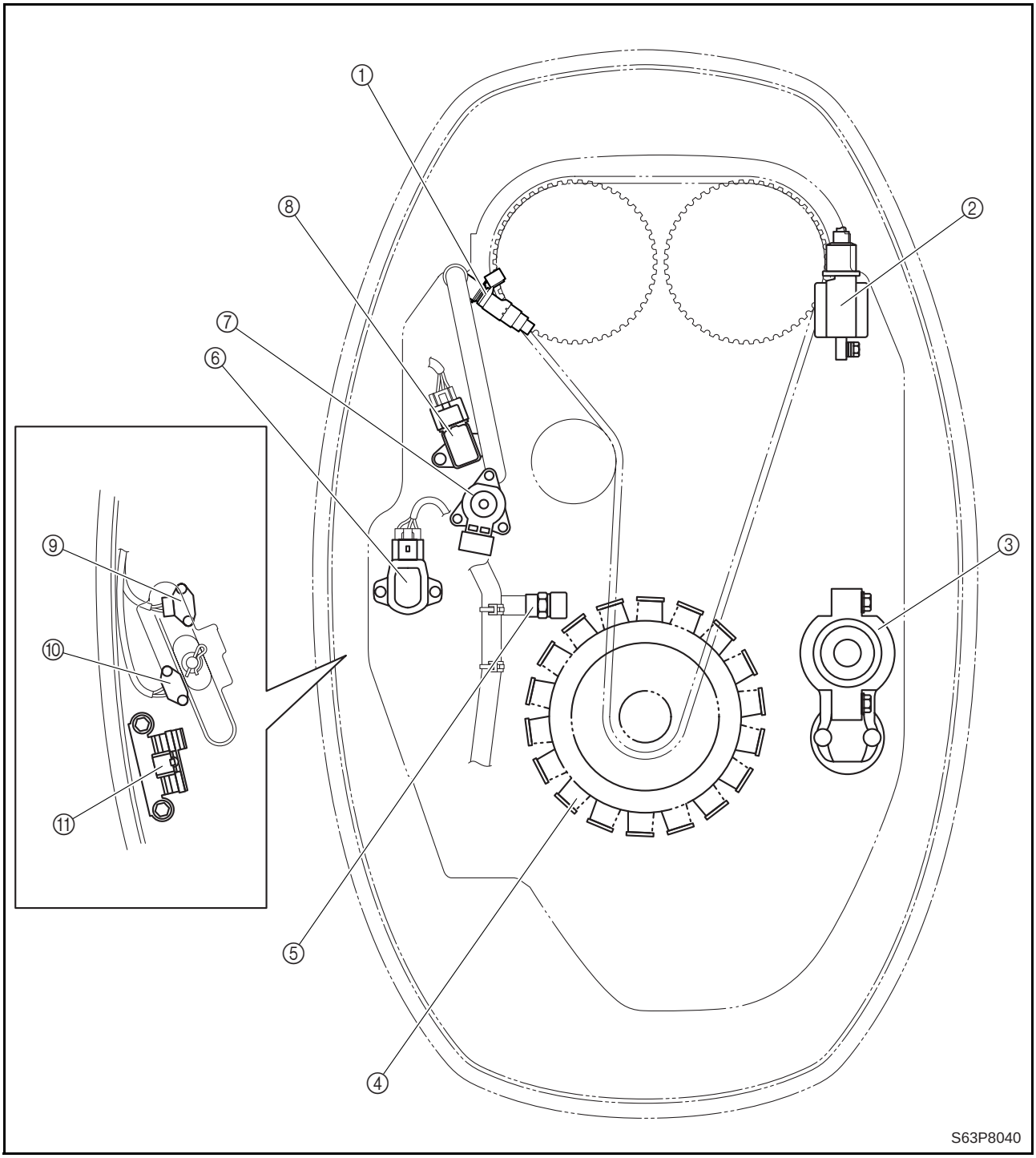
8

Aft view



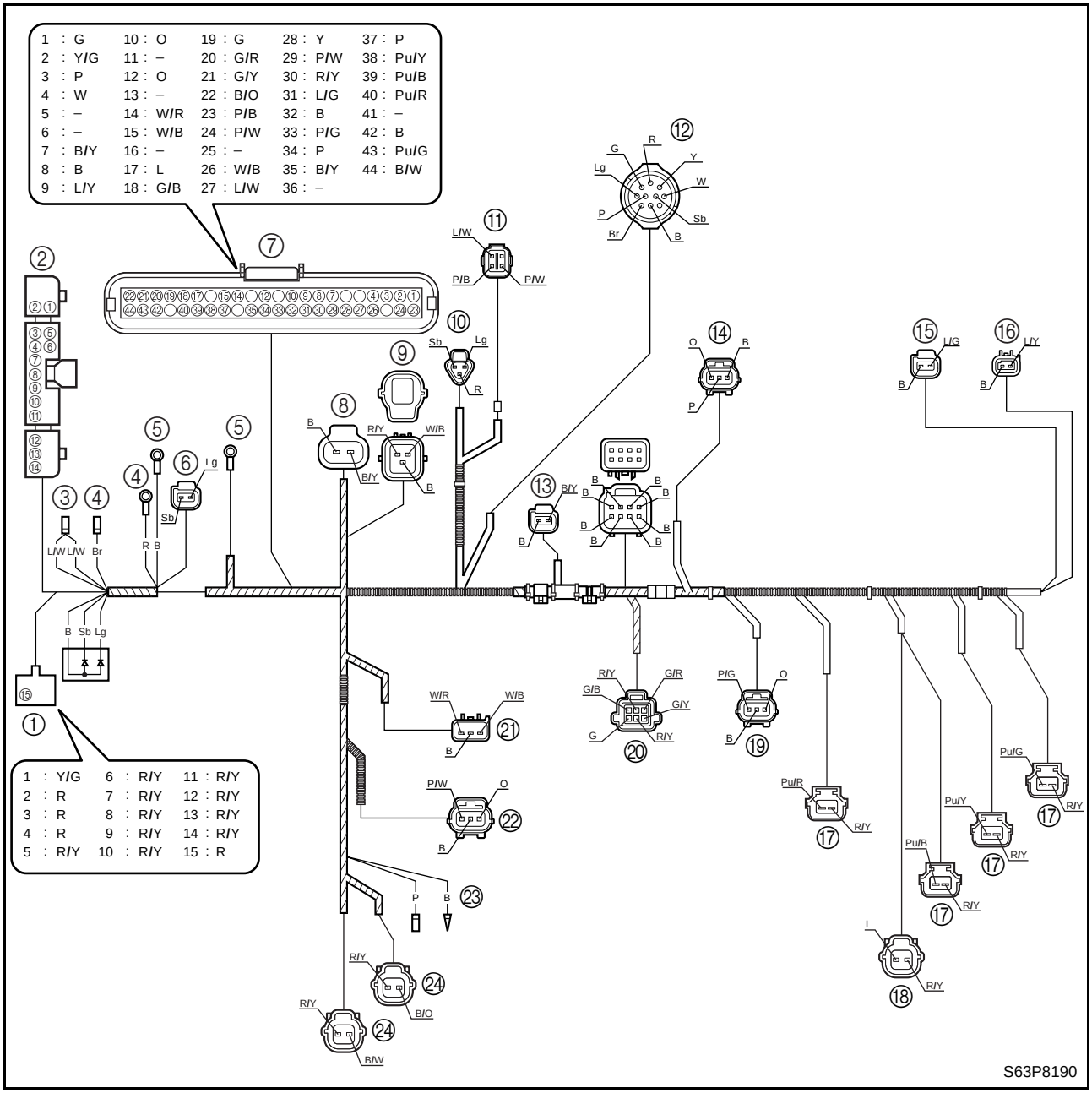
① Intake air pressure sensor
② Throttle position sensor
③ Fuel injector
④ Shift cut switch
⑤ Neutral switch
⑥ Ignition coil
⑦ Thermoswitch
⑧ Spark plug

Top view



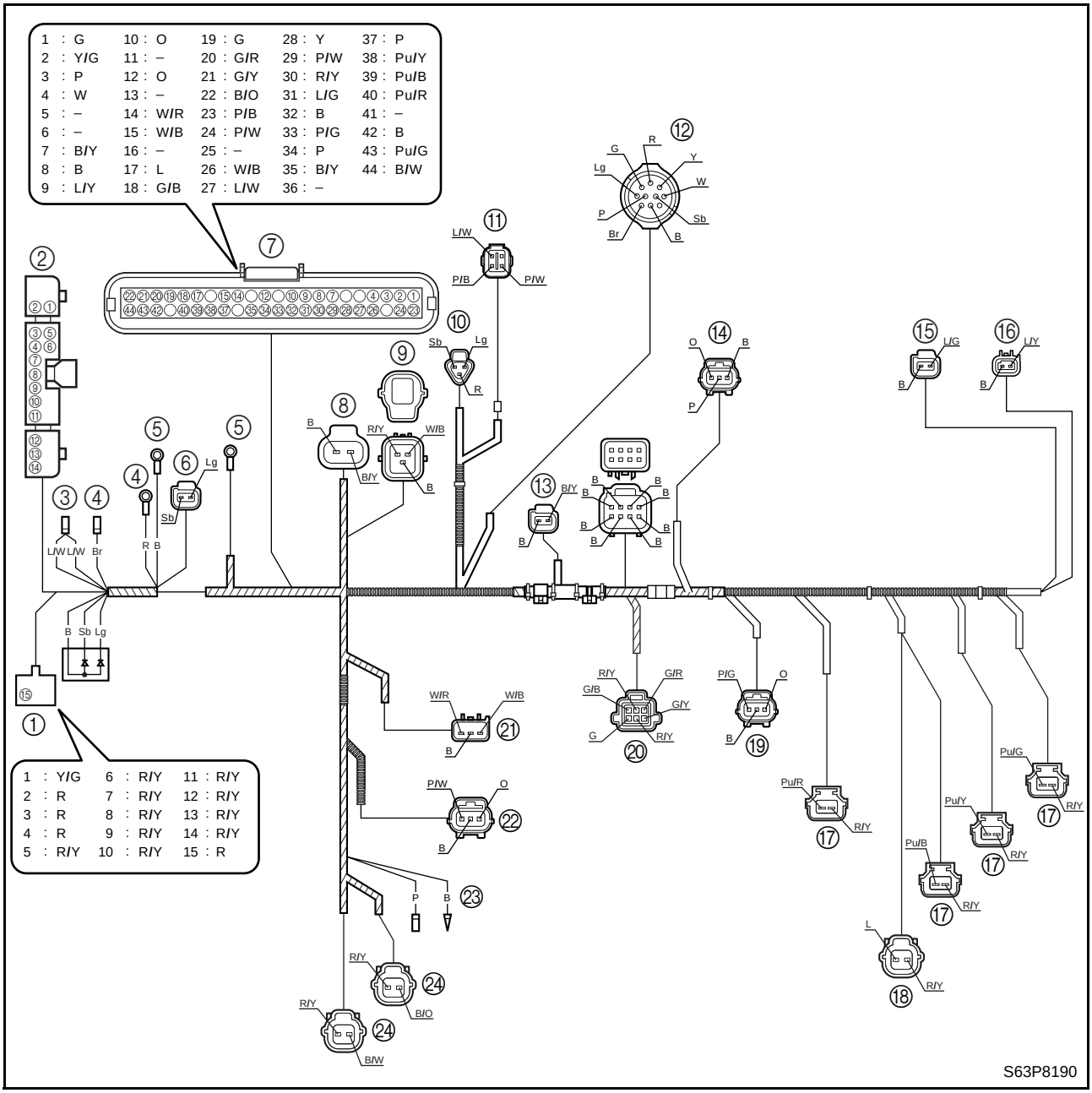
① Fuel injector
② Ignition coil
③ Starter motor
④ Stator coil
⑤ Engine temperature sensor
⑥ Throttle position sensor
⑦ Idle speed control
⑧ Intake air pressure sensor
⑨ Shift cut switch
⑩ Neutral switch
⑪ Power trim and tilt switch

Wiring harness



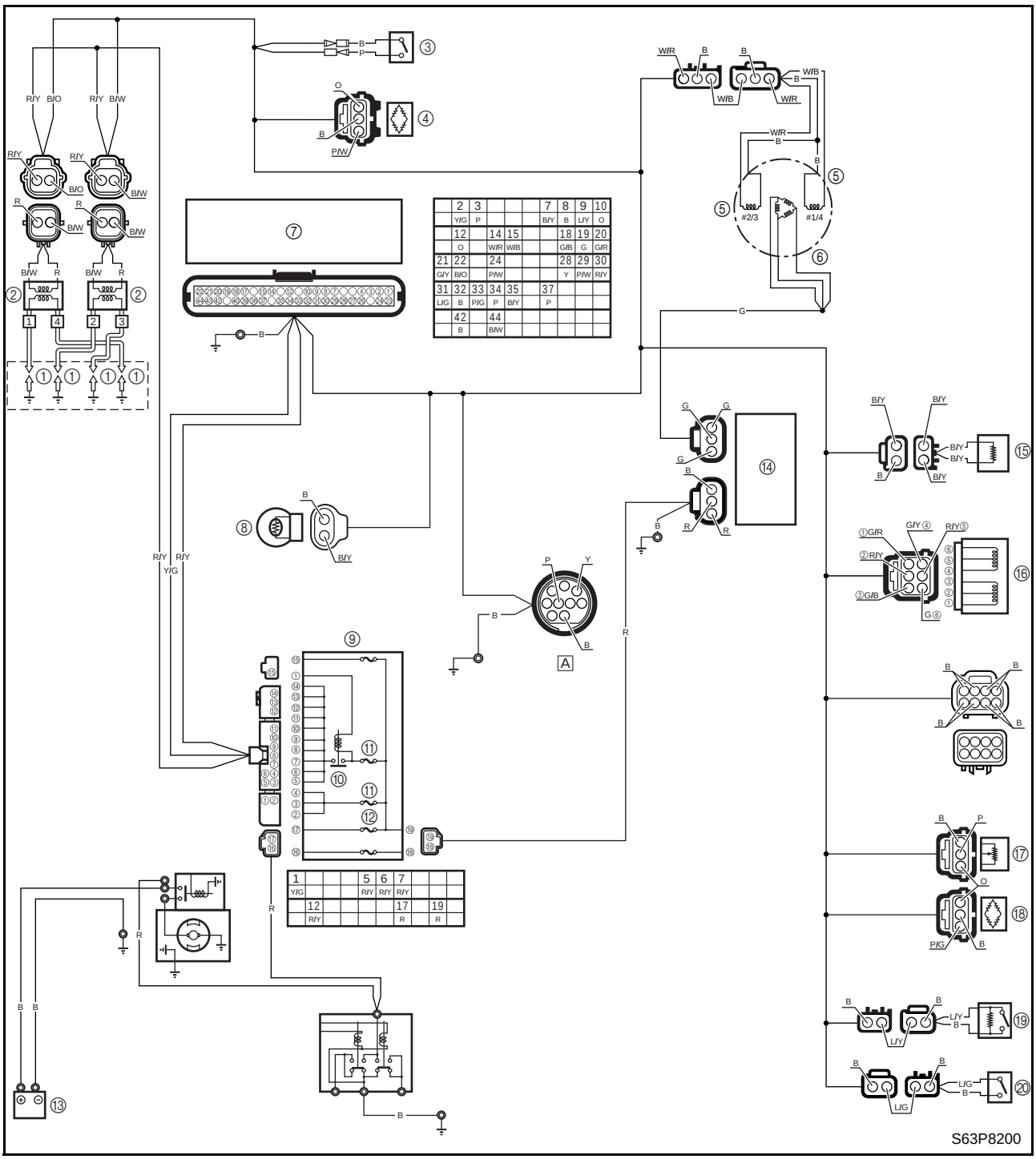
Connect to:

① Fuse holder
② Fuse holder
③ Diagnostic flash indicator
④ Starter relay
⑤ Ground
⑥ Power trim and tilt relay
⑦ ECM
⑧ Intake air temperature sensor
⑨ Personal computer for diagnosis
⑩ Power trim and tilt switch
⑪ Warning indicator
⑫ Remote control
⑬ Engine temperature sensor
⑭ Throttle position sensor
⑮ Neutral switch
⑯ Shift cut switch
⑰ Fuel injector
⑱ Electric fuel pump
⑲ Intake air pressure sensor
⑳ Idle speed control
㉑ Pulser coil
㉒ Oil pressure sensor
㉓ Thermoswitch
㉔ Ignition coil



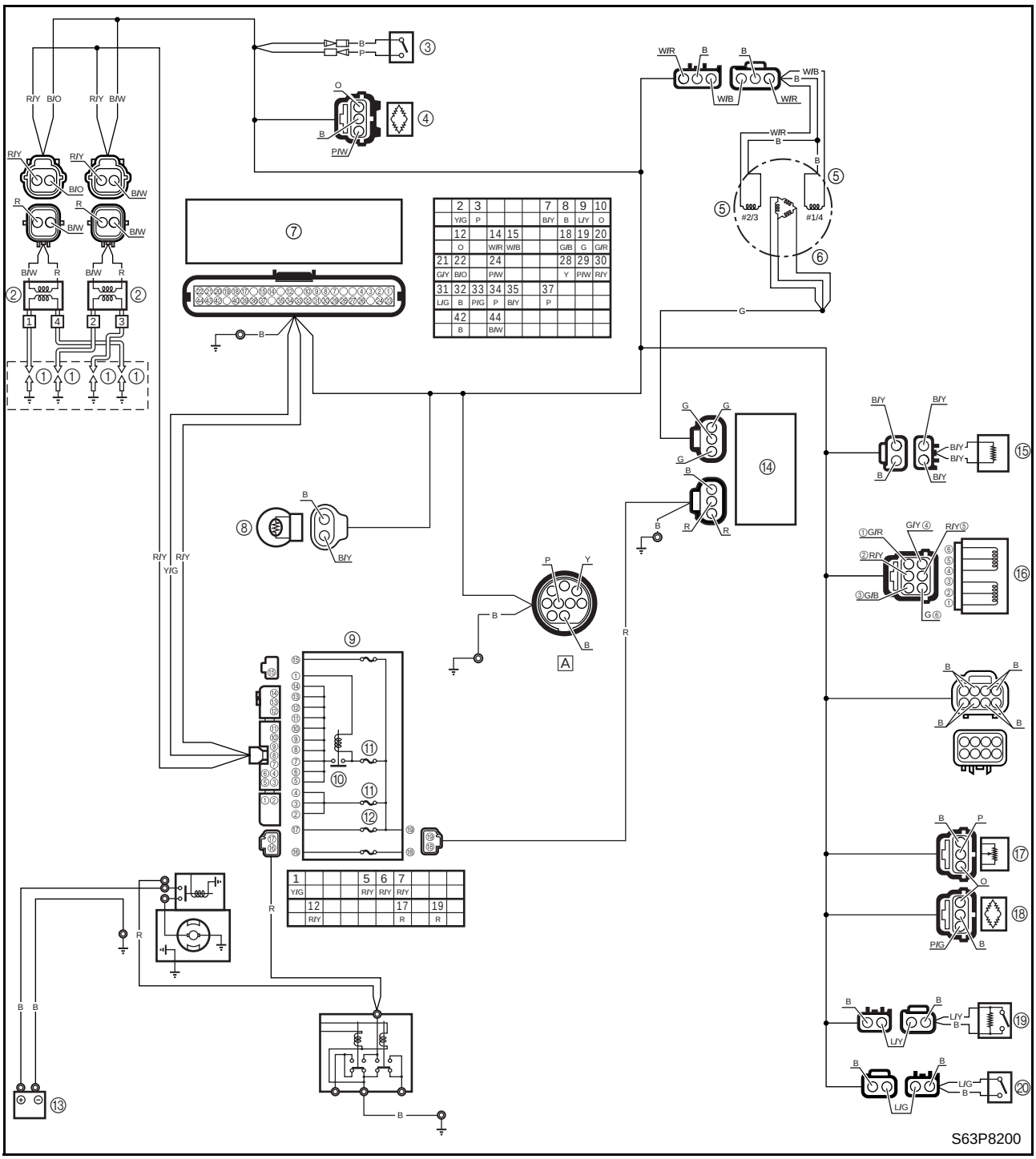
B	: Black	B/Y	: Black/yellow	R/Y	: Red/yellow
Br	: Brown	G/B	: Green/black	W/B	: White/black
G	: Green	G/R	: Green/red	W/R	: White/red
Gy	: Gray	G/Y	: Green/yellow	Y/G	: Yellow/green
L	: Blue	L/G	: Blue/green		
Lg	: Light green	L/W	: Blue/white		
O	: Orange	L/Y	: Blue/yellow		
P	: Pink	P/B	: Pink/black		
R	: Red	P/G	: Pink/green		
Sb	: Sky blue	P/W	: Pink/white		
W	: White	Pu/B	: Purple/black		
Y	: Yellow	Pu/G	: Purple/green		
B/O	: Black/orange	Pu/R	: Purple/red		
B/W	: Black/white	Pu/Y	: Purple/yellow		

Ignition and ignition control system



① Spark plug
② Ignition coil
③ Thermoswitch
④ Oil pressure sensor
⑤ Pulser coil
⑥ Stator coil
⑦ ECM
⑧ Intake air temperature sensor
⑨ Fuse holder
⑩ Main relay
⑪ Fuse (20 A)
⑫ Fuse (50 A)
⑬ Battery
⑭ Rectifier Regulator
⑮ Engine temperature sensor
⑯ Idle speed control
⑰ Throttle position sensor
⑱ Intake air pressure sensor
⑲ Shift cut switch
⑳ Neutral switch

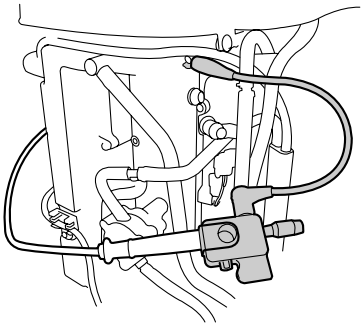
Ⓐ To remote control box/switch panel



B : Black
G : Green
O : Orange
P : Pink
R : Red
Y : Yellow
B/O : Black/orange
B/W : Black/white
B/Y : Black/yellow
G/B : Green/black
G/R : Green/red
G/Y : Green/yellow
L/G : Blue/green
L/Y : Blue/yellow
P/G : Pink/green
P/W : Pink/white
R/Y : Red/yellow
W/B : White/black
W/R : White/red
Y/G : Yellow/green

Checking the ignition spark gap

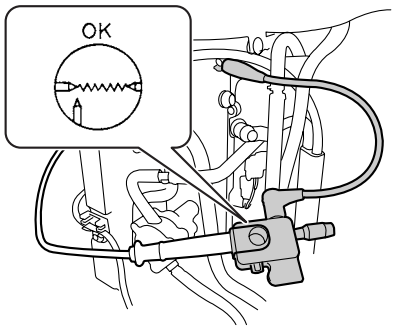
1. Remove the spark plug wire cover.
2. Disconnect the spark plug caps from the spark plugs.
3. Connect a spark plug cap to the special service tool.



S63P8070

Ignition tester: 90890-06754

4. Crank the engine and observe the spark through the discharge window of the spark gap tester. Check the ignition system if the spark is weak.



S63P8090

⚠ WARNING

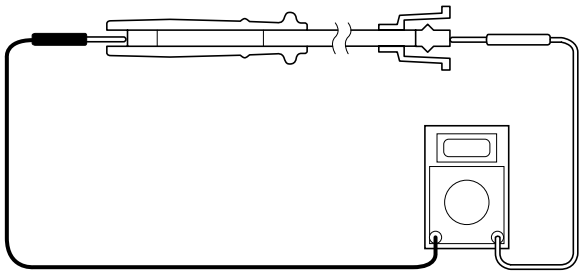
- **Do not touch any of the connections of the spark gap tester leads.**
- **Do not let sparks leak out of the removed spark plug caps.**
- **Keep flammable gas or liquids away, since this test can produce sparks.**

NOTE:

The ignition spark gap can also be checked using the “Stationary test” of the Diagnostic System.

Checking the spark plug wires

1. Remove the spark plug wires from the spark plugs.
2. Remove the spark plug wires from the ignition coil.
3. Measure the spark plug wire resistance. Replace if out of specification.

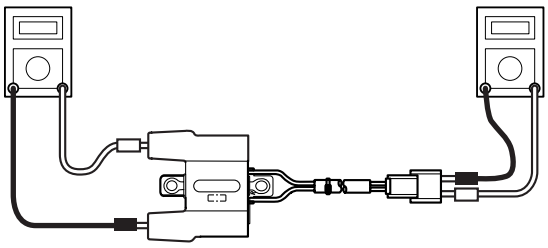


S60C8100

Spark plug wire resistance:
#1: 4.6–10.9 kΩ
#2: 3.3–8.0 kΩ
#3: 3.8–9.3 kΩ
#4: 4.2–10.0 kΩ

Checking the ignition coils

1. Remove the spark plug wires from the ignition coil.
2. Disconnect the ignition coil coupler.
3. Measure the ignition coil resistance. Replace if out of specification.

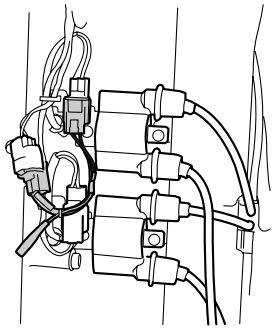


S63P8100

Ignition coil resistance:
Primary coil:
Red (R) – Black/white (B/W)
1.53–2.07 Ω at 20 °C (68 °F)
Secondary coil:
12.50–16.91 kΩ at 20 °C (68 °F)

Checking the ECM

1. Disconnect a ignition coil coupler.
2. Connect the test harness (2 pins) to the ignition coil.
3. Measure the ECM output peak voltage. If below specification, measure the pulser coil output peak voltage. Replace the ECM if the output peak voltage of the pulser coil is above specification.



S63P8110

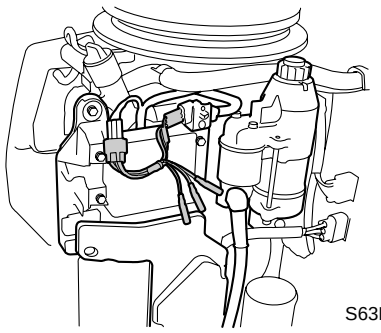
Digital circuit tester: 90890-03174
Peak voltage adapter B:
90890-03172
Test harness (2 pins): 90890-06792

ECM output peak voltage:
Black/orange (B/O) – Ground
Black/white (B/W) – Ground

r/min	Loaded		
	Cranking	1,500	3,500
DC V	260	260	270

Checking the pulser coil

1. Remove the flywheel magnet cover and disconnect the pulser coil coupler.
2. Connect the test harness (3 pins) to the pulser coil.
3. Measure the pulser coil output peak voltage. Replace the pulser coil if below specification.



S63P8120

Digital circuit tester: 90890-03174
Peak voltage adapter B:
90890-03172
Test harness (3 pins): 90890-06791

Pulser coil output peak voltage:
White/red (W/R) – Black (B)
White/black (W/B) – Black (B)

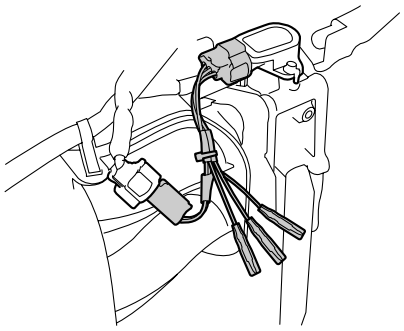
r/min	Unloaded	Loaded		
	Cranking		1,500	3,500
DC V	3.5	3.6	23.9	49.7

Pulser coil resistance
(use as reference):
459–561 Ω

8

Checking the throttle position sensor

1. Remove the flywheel magnet cover.
2. Connect the test harness (3 pins) to the throttle position sensor.
3. Turn the engine start switch to ON.
4. Measure the throttle position sensor input voltage. Check the wiring harness connection or replace the ECM if out of specification.
5. Measure the throttle position sensor output voltage. Adjust the throttle position sensor if out of specification.



S63P8130

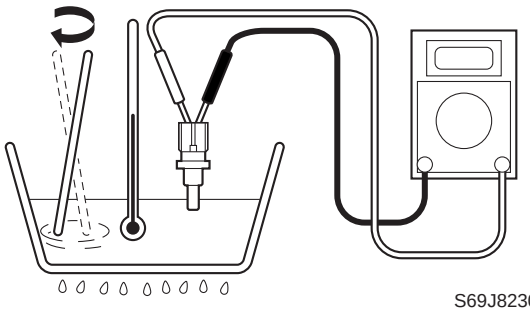
NOTE:
To measure the output voltage, connect the positive tester probe to the pink wire of the test harness and the negative tester probe to the orange wire of the test harness.

Digital circuit tester: 90890-03174
Test harness (3 pins): 90890-06793

Throttle position sensor input voltage:
Orange (O) – Black (B)
5 V
Throttle position sensor output voltage:
Pink (P) – Black (B)
0.70 ± 0.02 V

Checking the intake air temperature sensor

1. Place the intake air temperature sensor in a container of water and slowly heat the water.



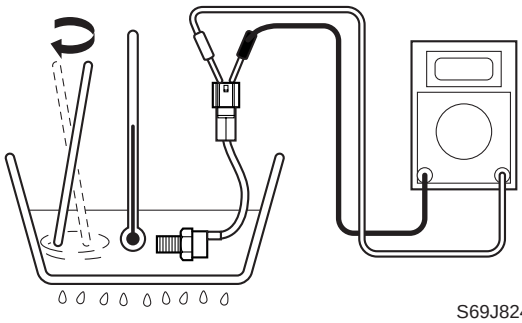
S69J8230

2. Measure the intake air temperature sensor resistance. Replace if out of specification.

Intake air temperature sensor resistance:
at 20 °C (68 °F): 2.20–2.70 kΩ

Checking the engine temperature sensor

1. Place the engine temperature sensor in a container of water and slowly heat the water.



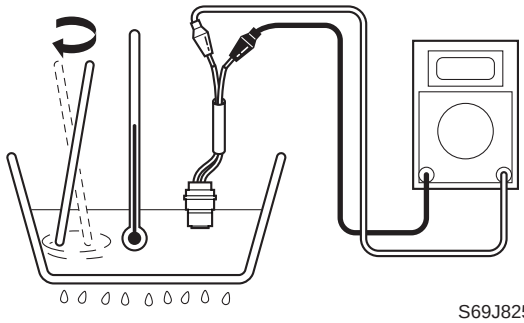
S69J8240

2. Measure the engine temperature sensor resistance. Replace if out of specification.

Engine temperature sensor resistance:
Black/yellow (B/Y) – Black/yellow (B/Y)
at 20 °C (68 °F): 54.2–69.0 kΩ
at 100 °C (212 °F): 3.12–3.48 kΩ

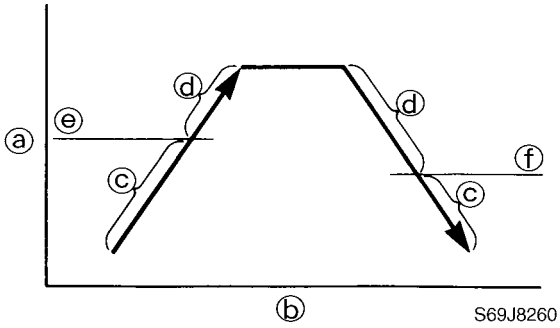
Checking the thermoswitch

1. Place the thermoswitches in a container of water and slowly heat the water.



S69J8250

2. Check the switch for continuity at the specified temperatures. Replace if out of specification.



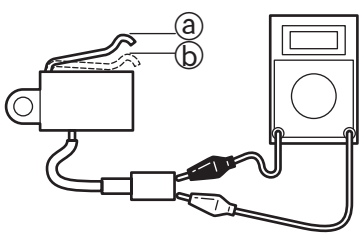
S69J8260

ⓐ Temperature
ⓑ Time
ⓒ No continuity
ⓓ Continuity

Thermoswitch continuity temperature:
Pink (P) – Black (B)
ⓔ: 84–90 °C (183–194 °F)
ⓕ: 68–82 °C (154–180 °F)

Checking the shift cut switch

1. Check the shift cut switch for continuity. Replace if there is no continuity.

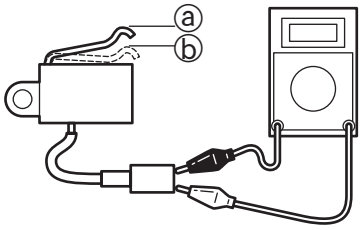


S69J8270

Switch position	Lead color	
	Blue/yellow (L/Y)	Black (B)
Free ⓐ		
Push ⓑ	○	○

Checking the neutral switch

1. Check the neutral switch for continuity. Replace if there is no continuity.

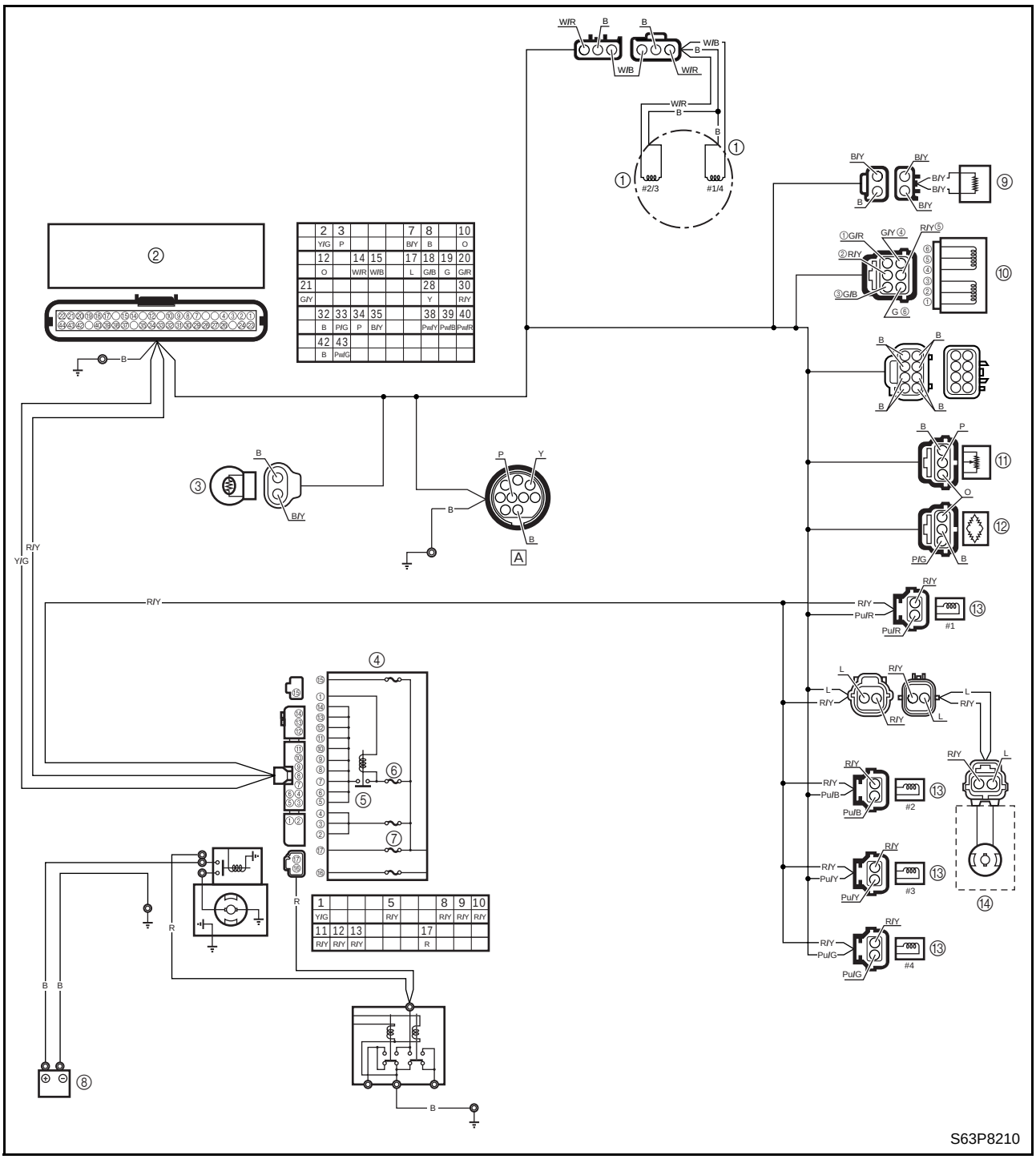


S69J8270

Switch position	Lead color	
	Blue/green (L/G)	Black (B)
Free ⓐ		
Push ⓑ	○	○

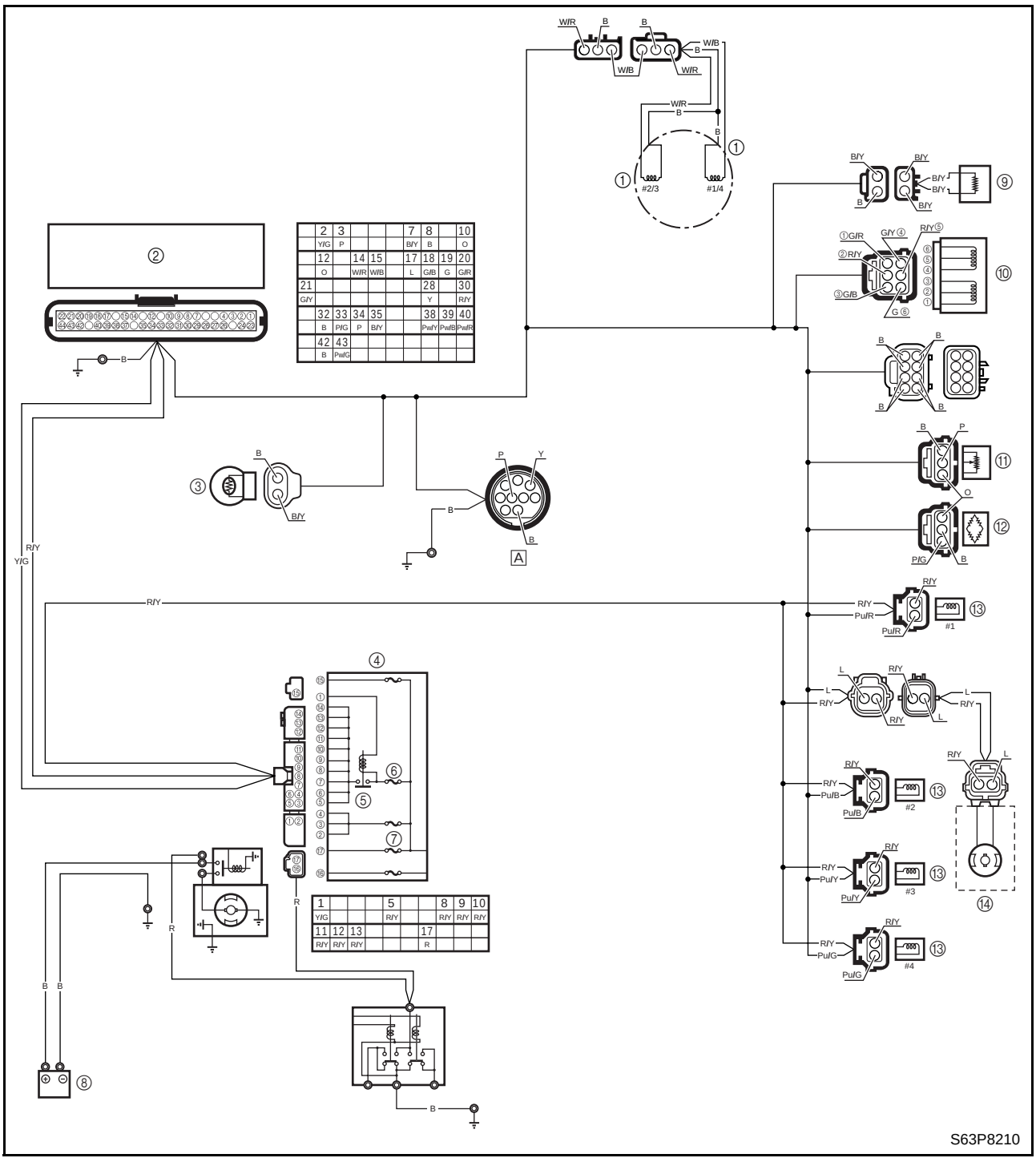
8

Fuel control system



① Pulser coil
② ECM
③ Intake air temperature sensor
④ Fuse holder
⑤ Main relay
⑥ Fuse (20 A)
⑦ Fuse (50 A)
⑧ Battery
⑨ Engine temperature sensor
⑩ Idle speed control
⑪ Throttle position sensor
⑫ Intake air pressure sensor
⑬ Fuel injector
⑭ Electric fuel pump

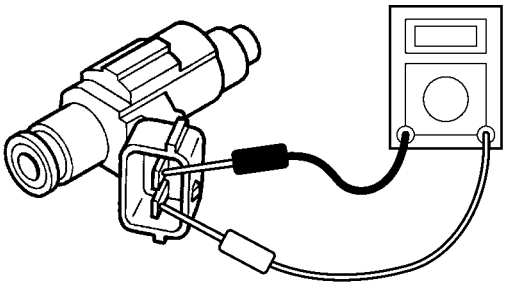
Ⓐ To remote control box/switch panel



B : Black
G : Green
L : Blue
O : Orange
P : Pink
R : Red
Y : Yellow
B/Y : Black/yellow
G/B : Green/black
G/R : Green/red
G/Y : Green/yellow
P/G : Pink/green
Pu/B : Purple/black
Pu/G : Purple/green
Pu/R : Purple/red
Pu/Y : Purple/yellow
R/Y : Red/yellow
W/B : White/black
W/R : White/red
Y/G : Yellow/green

Checking the injectors

1. Measure the resistance of the fuel injectors. Replace if out of specification.



S69J4150

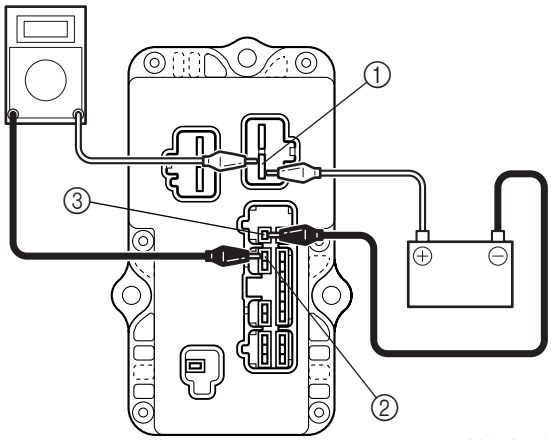
Digital circuit tester: 90890-03174

Fuel injector resistance
(use as reference):
14.0–15.0 Ω at 20 °C (68 °F)

NOTE:
Check the operation of the fuel injectors using the “Stationary test” of the Diagnostic System.

Checking the main relay

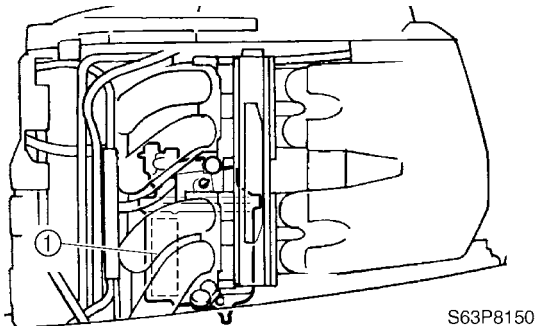
1. Remove the fuse holder cover, and then remove the fuse holder.
2. Connect the digital circuit tester leads to the main relay terminals ① and ②.
3. Connect the positive battery terminal to the main relay terminal ①.
4. Connect the negative battery terminal to the main relay terminal ③.
5. Check for continuity between the main relay terminals. Replace if there is no continuity.
6. Check that there is no continuity between the relay terminals after disconnecting a battery terminal from the main relay terminals ① and ③. Replace if there is continuity.



S60V8450

Checking the electric fuel pump

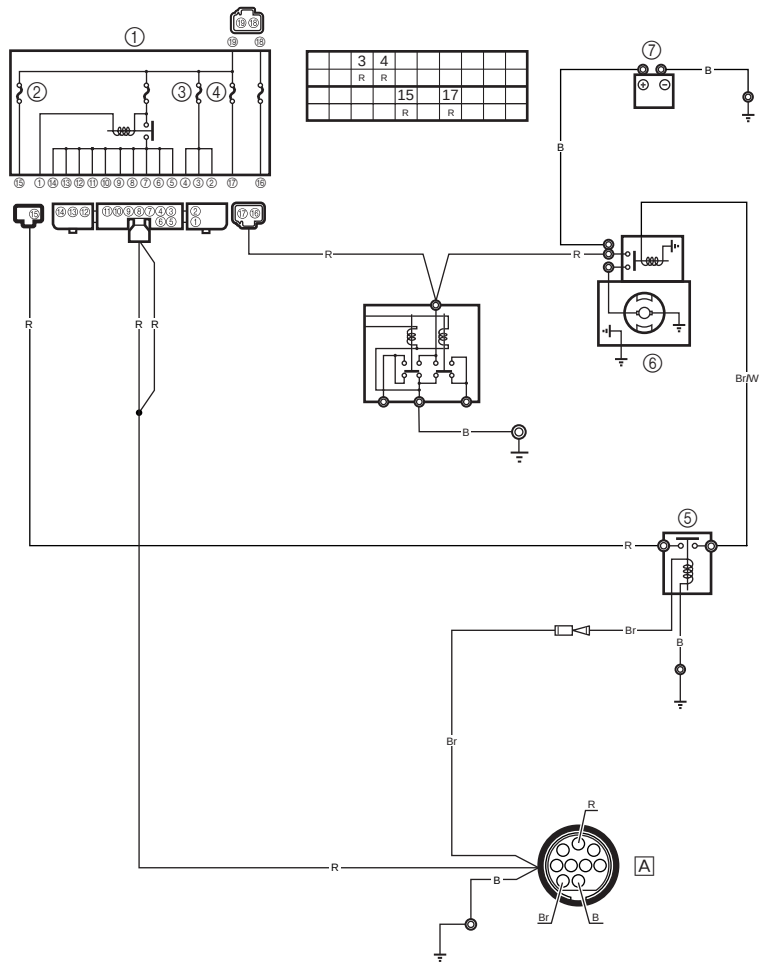
1. Turn the engine start switch to ON.
2. Listen for the operating sound of the electric fuel pump ①. Check the fuel system if there is no sound.



S63P8150

NOTE:
After the engine start switch is turned to ON, the electric fuel pump will operate for 3 seconds.

Starting system



S63P8220

① Fuse holder
② Fuse (30 A)
③ Fuse (20 A)
④ Fuse (50 A)
⑤ Starter relay
⑥ Starter motor
⑦ Battery

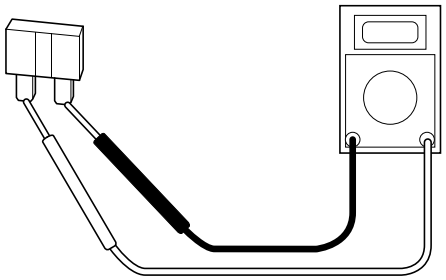
B : Black
Br : Brown
R : Red
Br/W : Brown/white

A To remote control box/switch panel

8

Checking the fuses

1. Check the fuses for continuity. Replace if there is no continuity.



S69J8340

Checking the starter relay

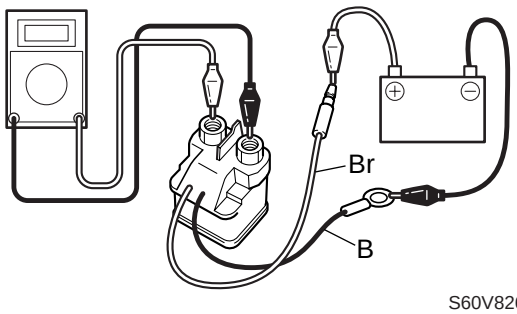
1. Connect the digital circuit tester leads to the starter relay terminals.

2. Connect the positive battery terminal to the brown (Br) lead.

3. Connect the negative battery terminal to the black (B) lead.

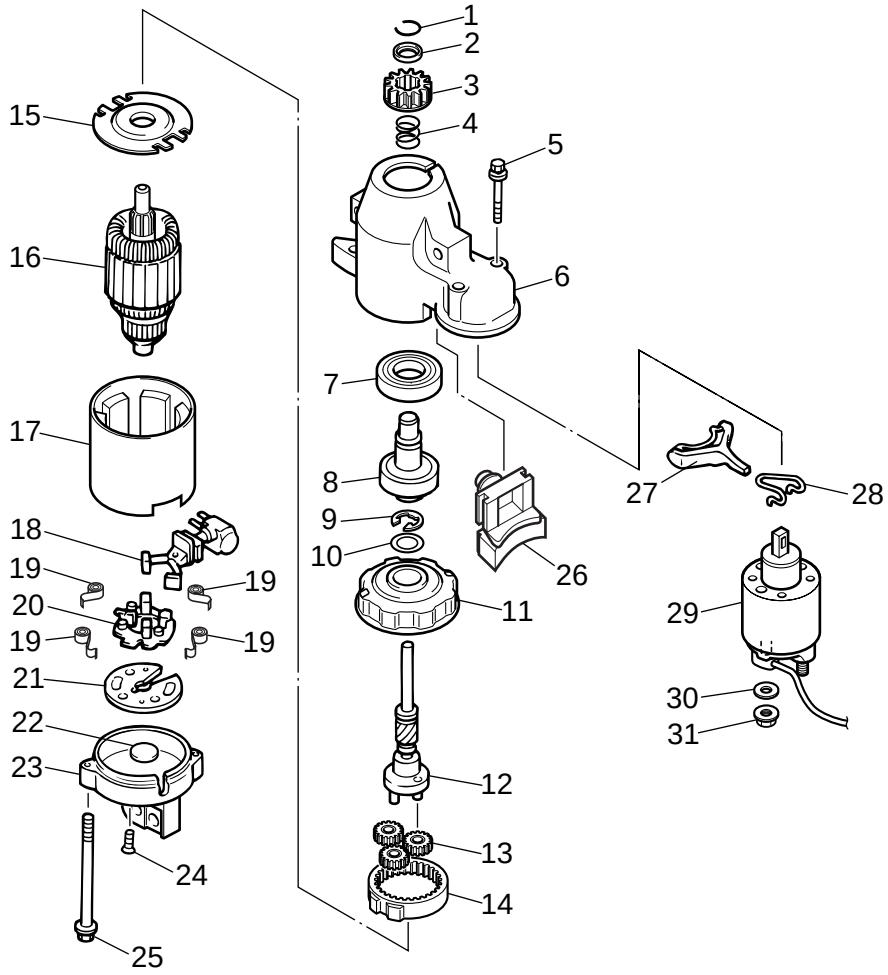
4. Check for continuity between the starter relay terminals. Replace if there is no continuity.

5. Check that there is no continuity between the starter relay terminals after disconnecting a battery terminal from the brown or black lead. Replace if there is continuity.



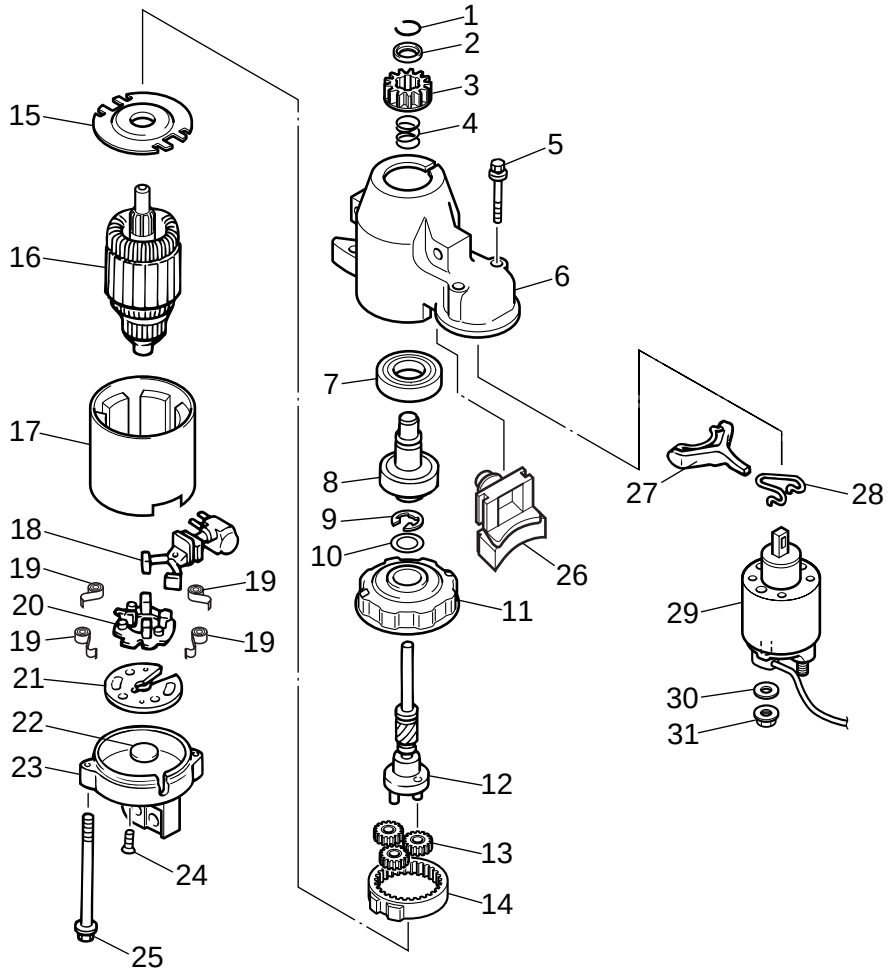
S60V8265

Starter motor



S63P8050

No.	Part name	Q'ty	Remarks
1	Clip	1	
2	Pinion stopper	1	
3	Starter motor pinion	1	
4	Spring	1	
5	Bolt	2	M6 × 35 mm
6	Housing	1	
7	Bearing	1	
8	Clutch assembly	1	
9	E-clip	1	**Not reusable**
10	Washer	1	
11	Bracket	1	
12	Pinion shaft	1	
13	Planetary gear	3	
14	Outer gear	1	
15	Plate	1	
16	Armature	1	
17	Stator	1	

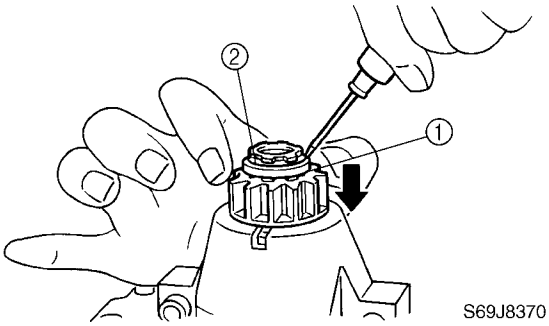


S63P8050

No.	Part name	Q'ty	Remarks
18	Brush assembly	1	
19	Brush spring	4	
20	Brush holder	1	
21	Plate	1	
22	Washer	1	
23	Bracket	1	
24	Screw	2	ø4 × 15 mm
25	Bolt	2	M6 × 120 mm
26	Rubber seal	1	
27	Shift lever	1	
28	Spring	1	
29	Magnet switch assembly	1	
30	Washer	1	
31	Nut	1	

Removing the starter motor pinion

1. Slide the pinion stopper ① down as shown, and then remove the clip ②.

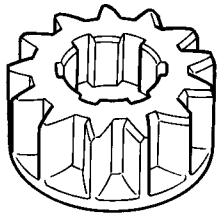


S69J8370

NOTE:
Remove the clip with a thin screwdriver.

Checking the starter motor pinion

1. Check the teeth of the pinion for cracks or wear. Replace if necessary.

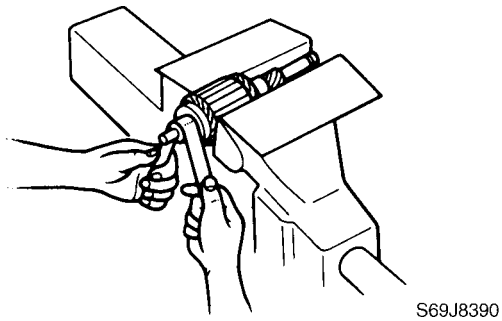

S69J8380

2. Check for smooth operation. Replace if necessary.

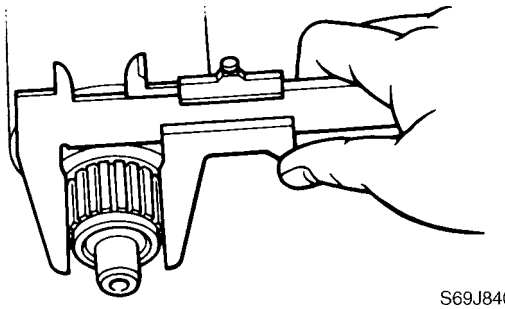
NOTE:
Turn the pinion counterclockwise to check that it operates smoothly and turn it clockwise to check that it locks in place.

Checking the armature

1. Check the commutator for dirt. Clean with 600–grit sandpaper and compressed air if necessary.

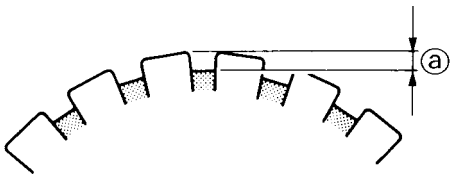

S69J8390

2. Measure the commutator diameter. Replace the armature if out of specification.


S69J8400

Commutator diameter limit:
28.0 mm (1.10 in)

3. Measure the commutator undercut ⓐ. Replace the armature if out of specification.

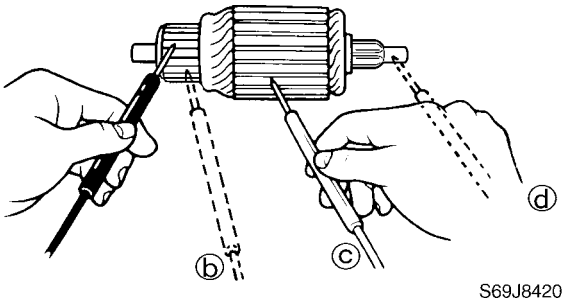


S69J8410

Commutator undercut limit ⓐ:
0.2 mm (0.01 in)

8

4. Check the armature for continuity. Replace if out of specifications.

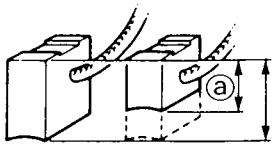


S69J8420

Armature continuity	
Commutator segments ⓑ	Continuity
Segment – Armature core ⓒ	No continuity
Segment – Armature shaft ⓓ	No continuity

Checking the brushes

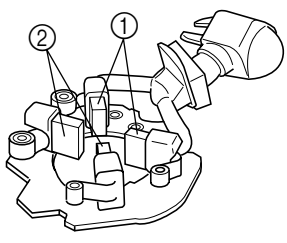
1. Measure the brush length. Replace the brush assembly if out of specification.



S69J8430

Brush length limit ⓐ:
9.5 mm (0.37 in)

2. Check the brush holder assembly for continuity. Replace if out of specifications.

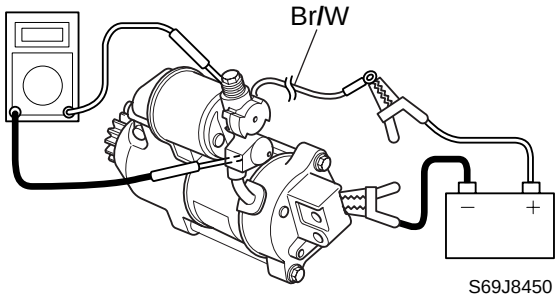


S69J8440

Brush continuity	
Brush ① – Brush ②	No continuity

Checking the magnet switch

1. Connect the tester leads between the magnet switch terminals as shown.
2. Connect the positive battery lead to the brown and white (Br/W) lead.
3. Connect the negative battery lead to the starter motor body.



S69J8450

CAUTION:

Do not connect the battery for more than one second, otherwise the magnet switch can be damaged.

4. Check that there is continuity between the magnet switch terminals. Replace if there is no continuity.
5. Check that there is no continuity after the negative battery terminal is removed. Replace if there is continuity.

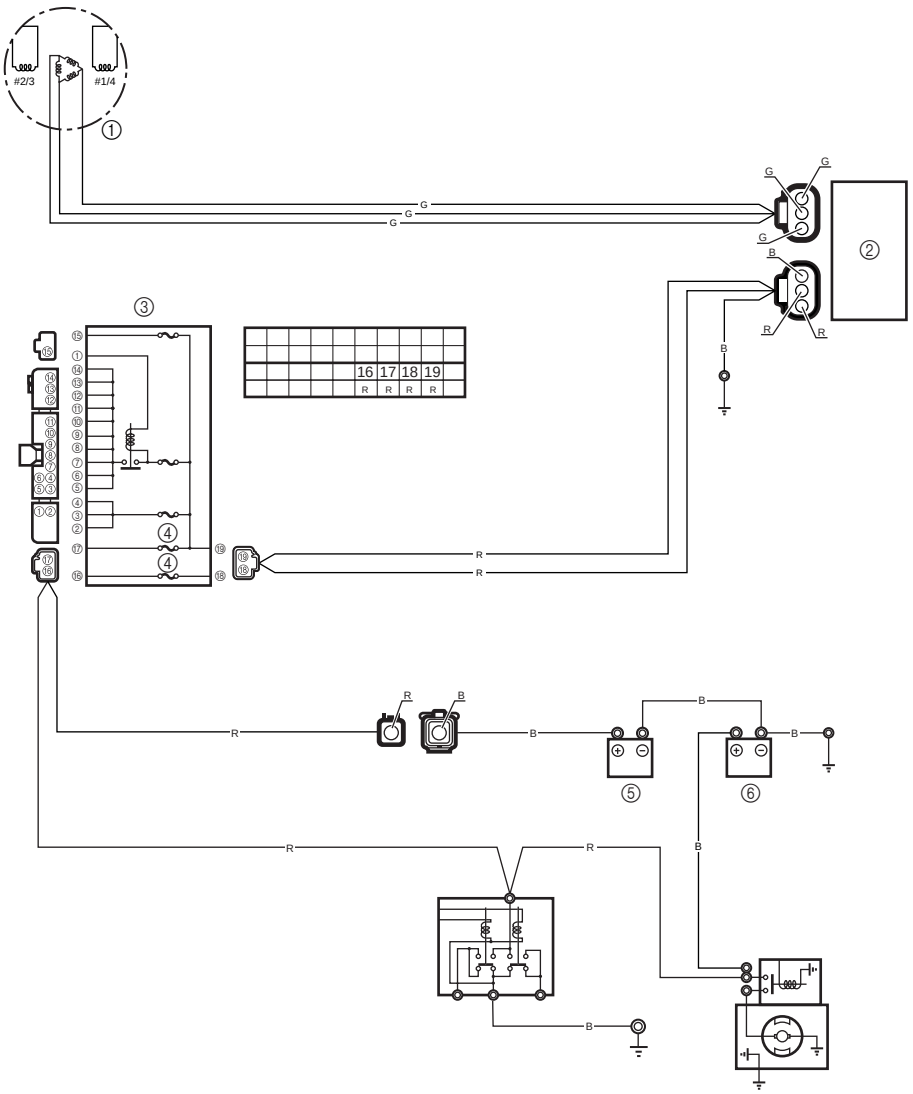
NOTE:

The starter motor pinion should be pushed out while the magnet switch is on.

Checking the starter motor operation

1. Check the operation of the starter motor after installing it onto the power unit.

Charging system



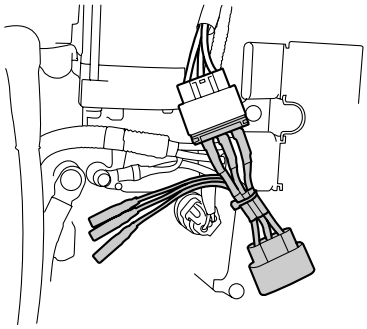
S63P8230

① Stator coil
② Rectifier Regulator
③ Fuse holder
④ Fuse (50 A)
⑤ Accessory battery
⑥ Battery

B : Black
G : Green
R : Red

Checking the stator coil

1. Disconnect the stator coil coupler.
2. Connect the test harness (3 pins) to the stator coil.
3. Measure the stator coil output peak voltage. Replace the stator coil assembly if below specification.



S63P8160

Digital circuit tester: 90890-03174
Peak voltage adapter B: 90890-03172
Test harness (3 pins): 90890-06847

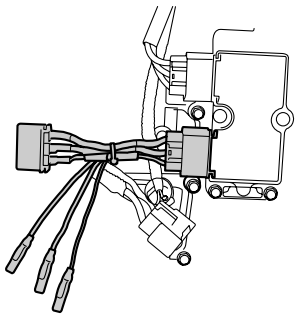
Stator coil output peak voltage:
Green (G) – Green (G)

r/min	Unloaded		
	Cranking	1,500	3,500
DC V	12	50	110

Stator coil resistance
(use as reference):
Green (G) – Green (G)
0.20–0.30 Ω at 20 °C (68 °F)

Checking the Rectifier Regulator

1. Disconnect the Rectifier Regulator coupler.
2. Connect the test harness (3 pins) to the Rectifier Regulator.
3. Measure the Rectifier Regulator output peak voltage. If below specification, measure the stator coil output peak voltage. Replace the Rectifier Regulator if the output peak voltage of the stator coil is above specification.



S63P8170

Digital circuit tester: 90890-03174
Peak voltage adapter B: 90890-03172
Test harness (3 pins): 90890-06846

Rectifier Regulator output peak voltage:
Red (R) – Black (B)

r/min	Unloaded	
	1,500	3,500
DC V	13.0	13.0

TRBL SHTG ?

Troubleshooting

Special service tools 9-1

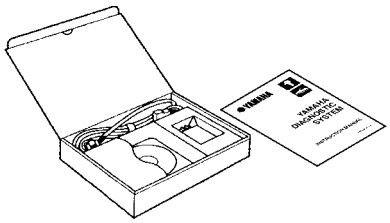
Diagnostic System 9-2
Introduction 9-2

Power unit 9-5

Self-diagnosis 9-19
Diagnosing the electronic control system 9-19

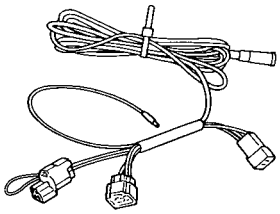
9

Special service tools



Diagnostic System
60V-85300-02

Diagnostic System
60V-WS853-02



Diagnostic flash indicator B
90890-06865

Diagnostic System

Introduction

Features

The newly developed Diagnostic System provides quicker detection and analysis of engine malfunctions for quicker troubleshooting procedures than traditional methods.
By connecting your computer to the ECM (Electronic Control Module) of an outboard motor using the communication cable, this software can be used to display sensor data and data stored in the ECM on a computer's monitor.
If this software is run on Microsoft Windows® 95, Windows 98, Windows Me, Windows 2000, or Windows XP the information can be displayed in colorful graphics. Also, the software can be operated using either a mouse or a keyboard.
In addition, the data for the main functions (Diagnosis, Diagnosis record, Engine monitor, and Data logger) can be saved on a disk or printed out.

Functions

1. **Diagnosis:** With the engine main switch ON, each sensor's status and each ECM diagnosis code or item is displayed. This enables you to find malfunctioning parts and controls quickly.

2. **Diagnosis record:** Sensors that had been activated and ECM diagnostic codes that have been recorded are displayed. This allows you to check the outboard motor's record of malfunctions.

3. **Engine monitor:** Each sensor status and the ECM data are displayed while the engine is running. This enables you to find malfunctioning parts quickly.

4. **Stationary test:** With the engine off, the ignition, fuel injection, electric fuel pump, and ISC valve are checked. These tests can be performed quickly.

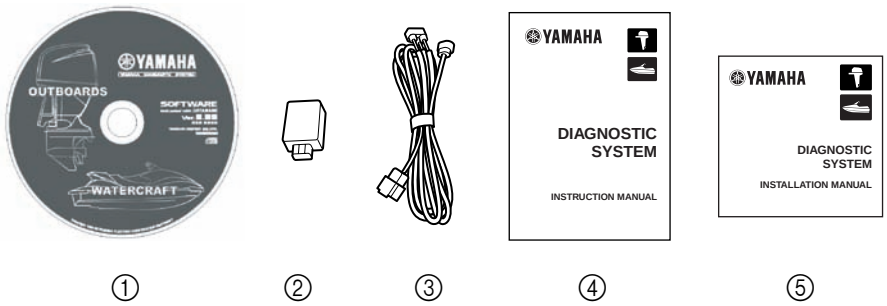
5. **Active test:** With the engine running the ISC valve is checked.

6. **Data logger:** Displays 13 minutes of recorded data for two or more of the items stored in the ECM. In addition, the operating time as compared to the engine speed and the total operating time are displayed. This allows you to check the operating status of the engine.

7. **Some files:** Lets you select and run other applications while continuing to run the diagnostic program.

Contents

1. Software (1)
2. Adapter (1)
3. Communication cable (1)
4. Instruction Manual (1)
5. Installation Manual (1)



① ② ③ ④ ⑤

9

Hardware requirements

Make sure that your computer meets the following requirements before using this software.

Computer:	IBM-compatible computer
Operating system:	Microsoft (Windows 95,) Windows 98, Windows Me, Windows 2000, or Windows XP (English version)
CPU:	
Windows 95/98:	i486X, 100 MHz or higher (Pentium 100 MHz or higher recommended)
Windows Me/2000:	Pentium, 166 MHz or higher (Pentium 233 MHz or higher recommended)
Windows XP:	Pentium, 300 MHz or higher (Pentium 500 MHz or higher recommended)
Memory:	
Windows 95/98:	16 MB or more (32 MB or more recommended)
Windows Me:	32 MB or more (64 MB or more recommended)
Windows 2000:	64 MB or more (128 MB or more recommended)
Windows XP:	128 MB or more (256 MB or more recommended)
Hard disk free space:	20 MB or more (40 MB or more recommended)
Drive:	CD-ROM drive
Display:	VGA (640 × 480 pixels), (SVGA [800 × 600 pixels] or more recommended) 256 or more colors
Mouse:	Compatible with the operating systems mentioned above
Communication port:	RS232C (Dsub-9 pin) port, USB port
Printer:	Compatible with the operating systems mentioned above

NOTE:

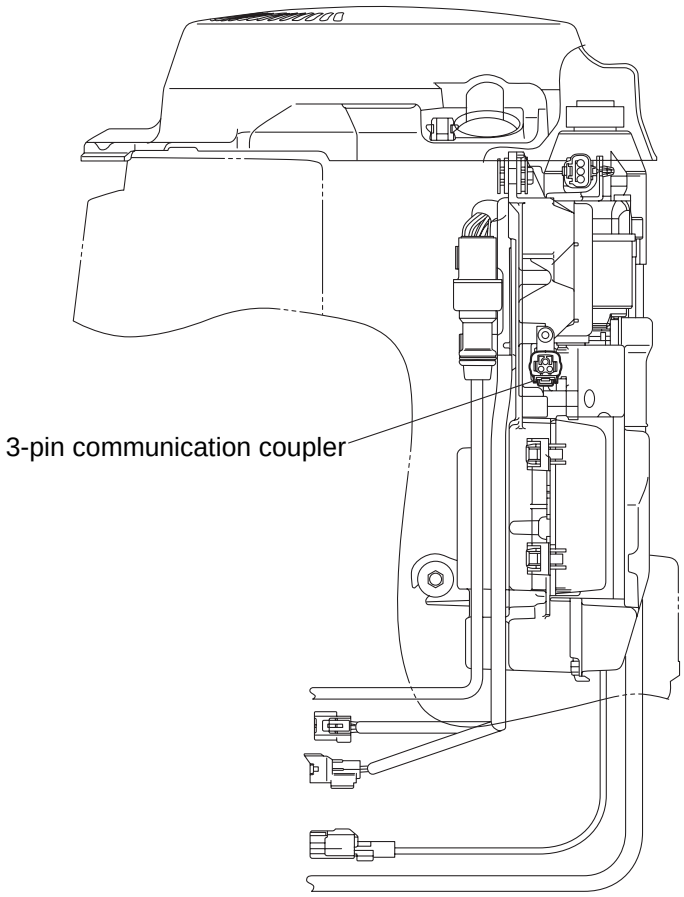
- The amount of memory and the amount of free space on the hard disk differs depending on the computer.
- Using this software while there is not enough free space on the hard disk could cause errors and result in insufficient memory.
- This software will not run properly on some computers.
- When starting up this program, do not start other software applications.
- Do not use the screen saver function or the energy saving feature when using this program.
- If the ECM is changed, restart the program.
- Window XP is a multiuser operating system, therefore, be sure to end this program if the login user is changed.
- The USB adapter cannot be used with Windows 95.

For operating instructions of the Diagnostic System, refer to the " Diagnostic System Instruction Manual."

Connecting the communication cable to the outboard motor

Models: F(L)150A

Bow view



S63P9030

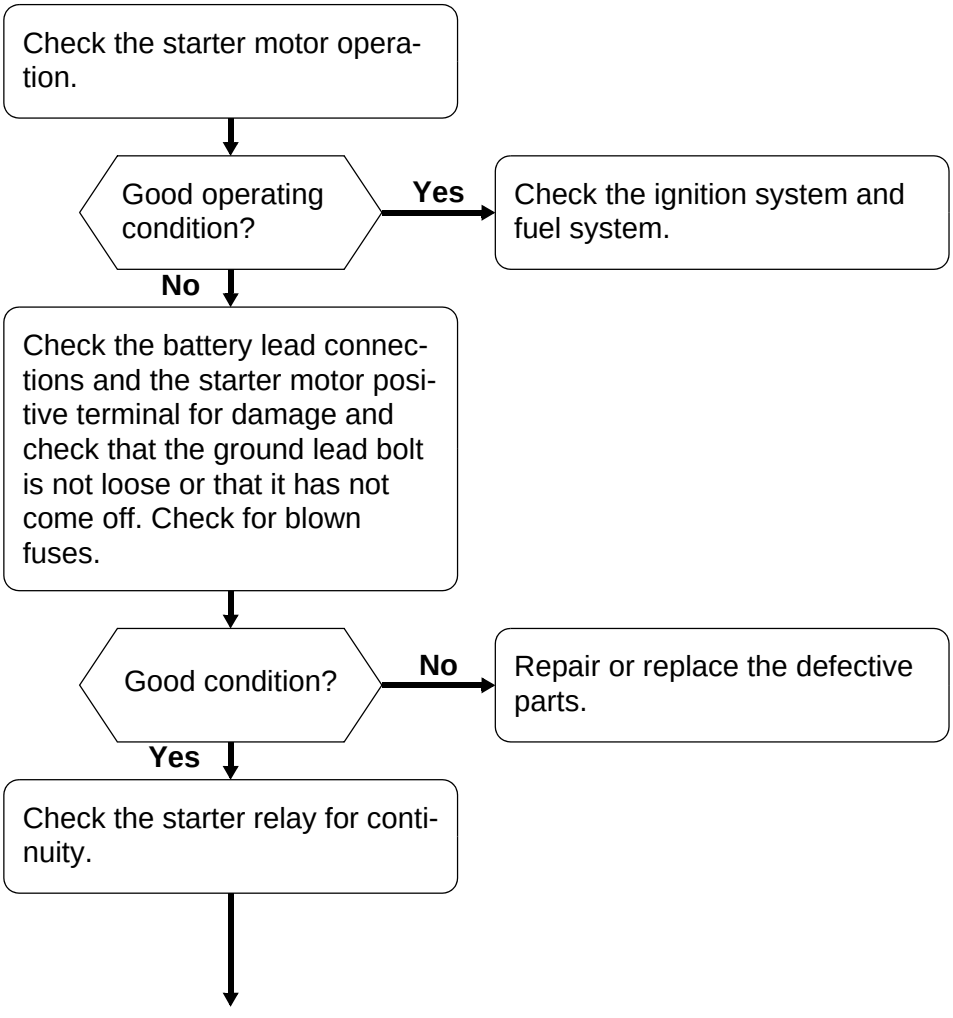
9

NOTE:
- Before troubleshooting the outboard motor, check the compression pressure, the mounting and rigging of the outboard motor, and the operation of the engine start switch. Also, make sure that specified fuel has been used and that the battery is fully charged.
- To diagnose a mechanical malfunction, use the troubleshooting charts for each trouble located in this chapter. Also, when checking and maintaining the outboard motor, see Chapters 3–8 for safe maintenance procedures.
- To diagnose a sensor or switch malfunction, use the diagnostic flash indicator to determine the cause.

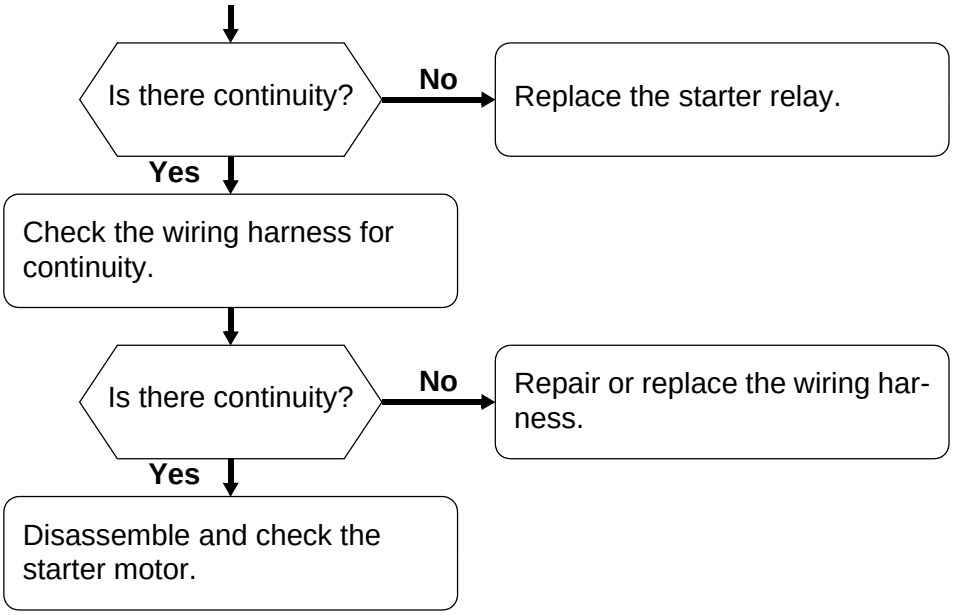
Power unit

Symptom 1: Engine does not start, or starting the engine is difficult.

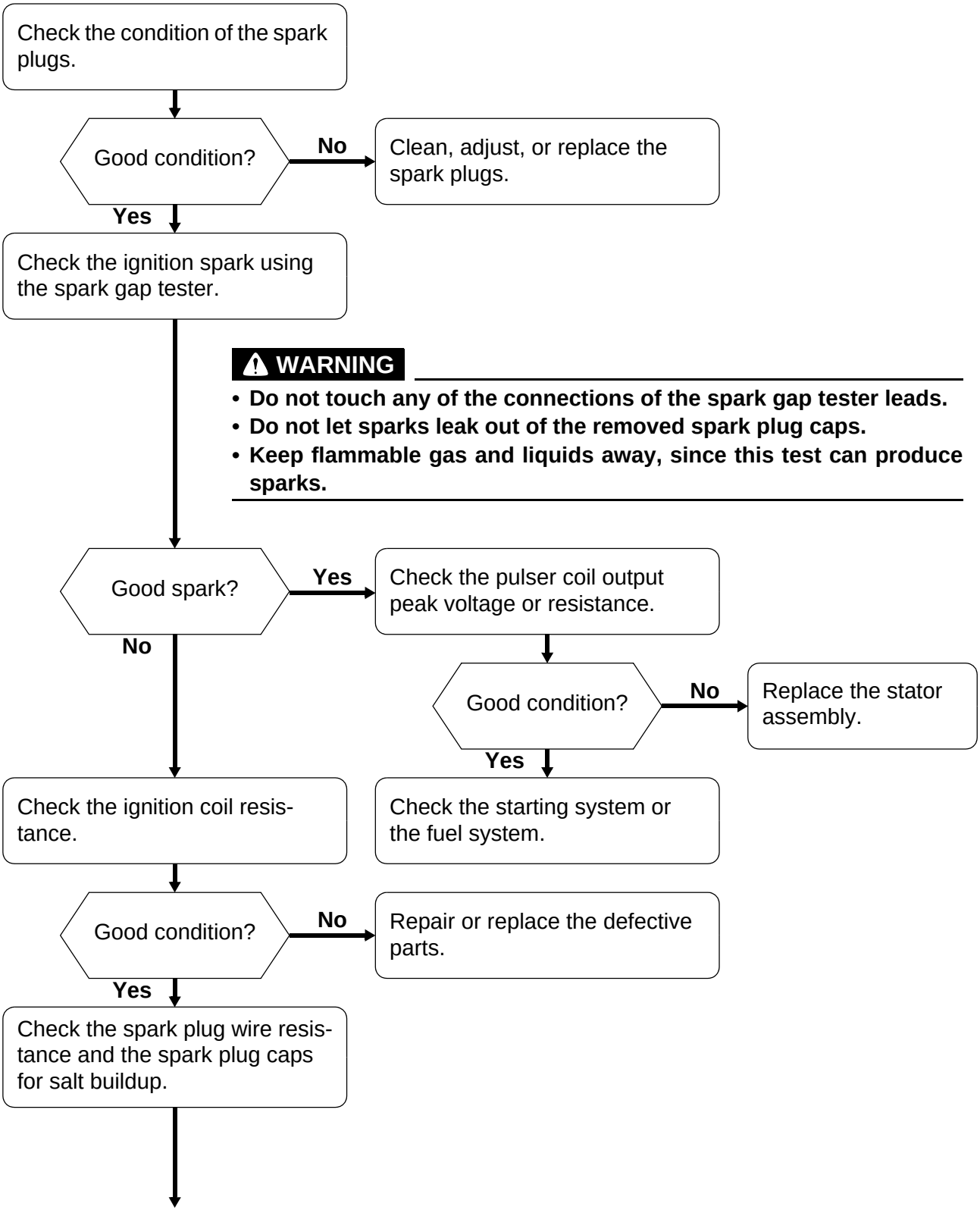
Starting system


Check the starter motor operation.
Good operating condition?
Yes
Check the ignition system and fuel system.
No
Check the battery lead connections and the starter motor positive terminal for damage and check that the ground lead bolt is not loose or that it has not come off. Check for blown fuses.
Good condition?
No
Repair or replace the defective parts.
Yes
Check the starter relay for continuity.

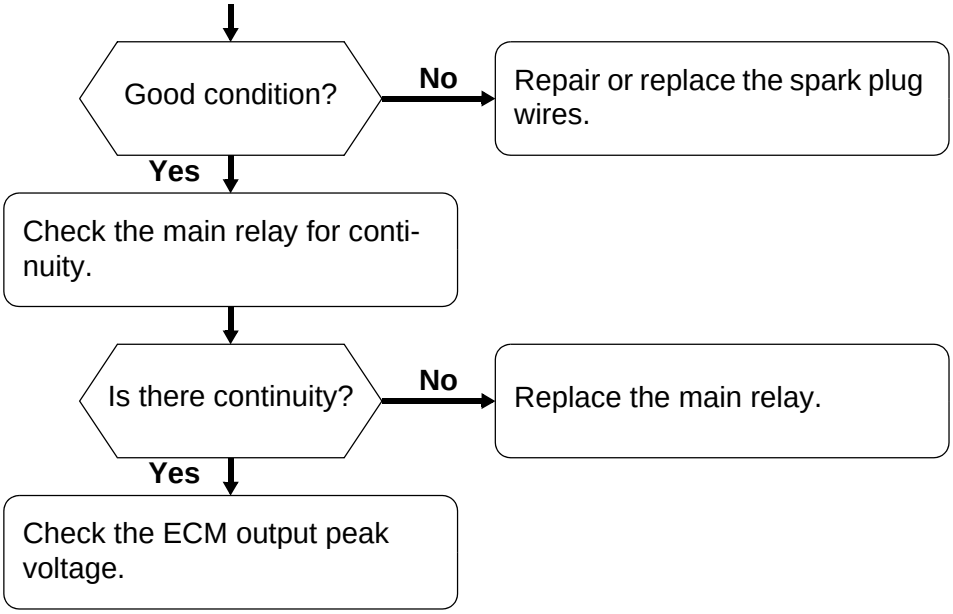
Continued on next page.


Is there continuity?
No
Replace the starter relay.
Yes
Check the wiring harness for continuity.
Is there continuity?
No
Repair or replace the wiring harness.
Yes
Disassemble and check the starter motor.

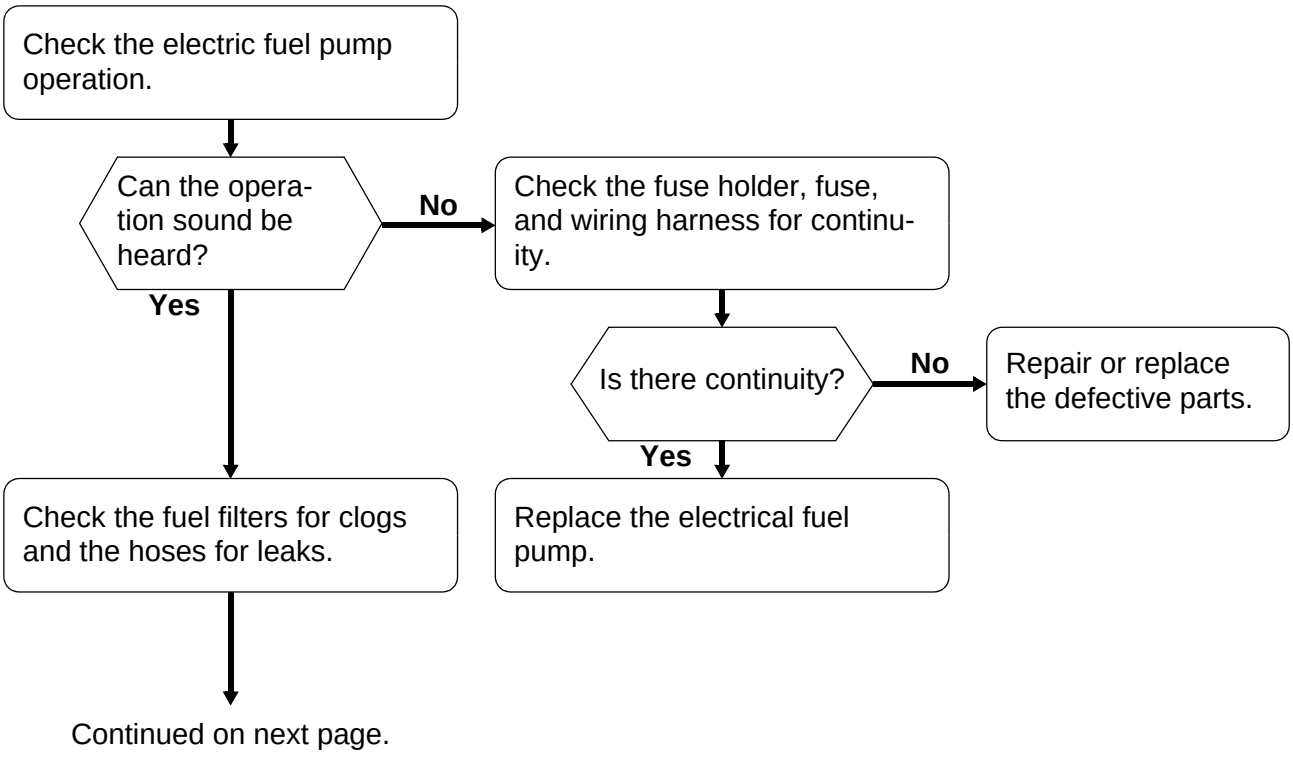
Ignition system


Check the condition of the spark plugs.
Good condition?
No
Clean, adjust, or replace the spark plugs.
Yes
Check the ignition spark using the spark gap tester.
WARNING
• Do not touch any of the connections of the spark gap tester leads.
• Do not let sparks leak out of the removed spark plug caps.
• Keep flammable gas and liquids away, since this test can produce sparks.
Good spark?
Yes
Check the pulser coil output peak voltage or resistance.
No
Good condition?
No
Replace the stator assembly.
Yes
Check the starting system or the fuel system.
Check the ignition coil resistance.
Good condition?
No
Repair or replace the defective parts.
Yes
Check the spark plug wire resistance and the spark plug caps for salt buildup.

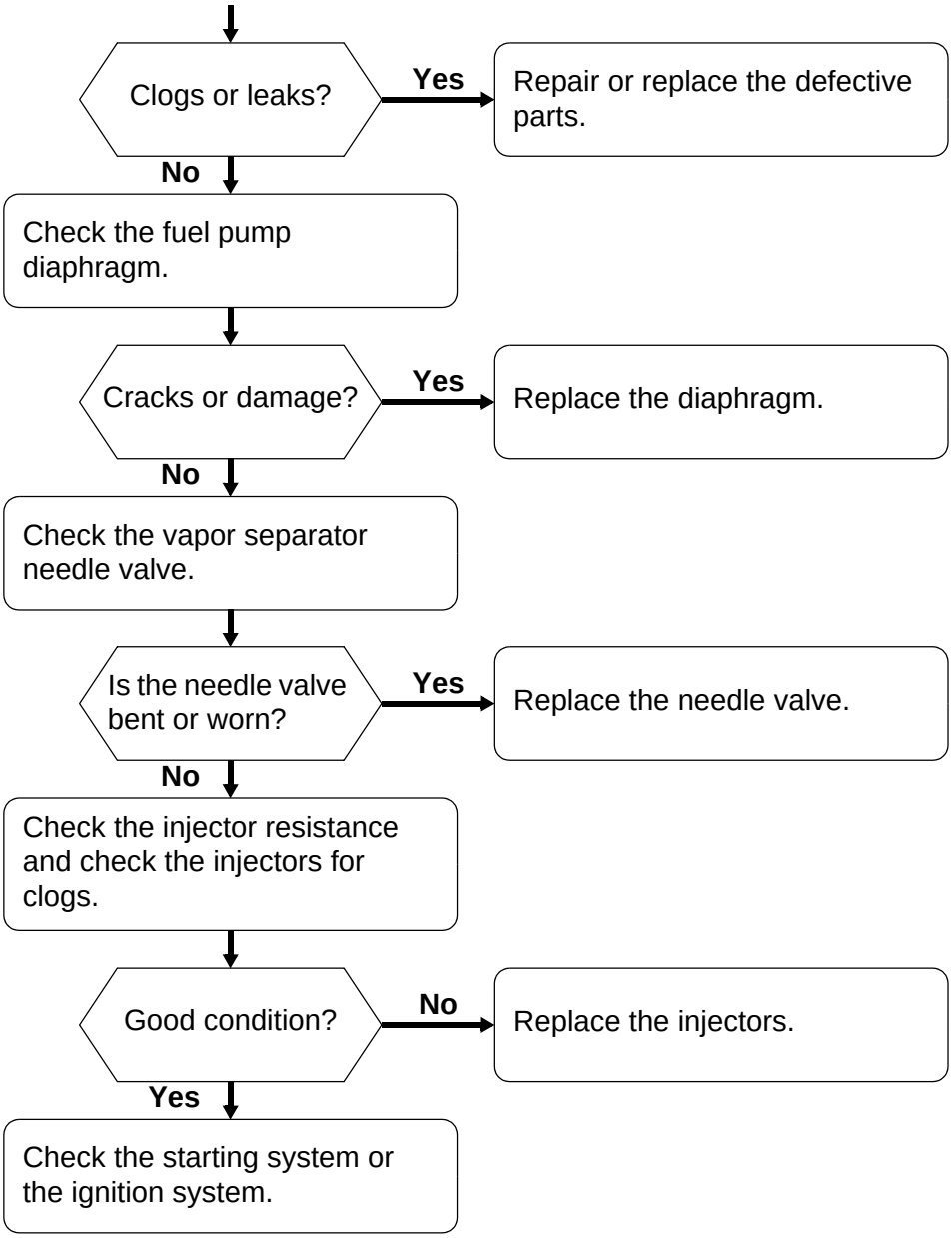
Continued on next page.



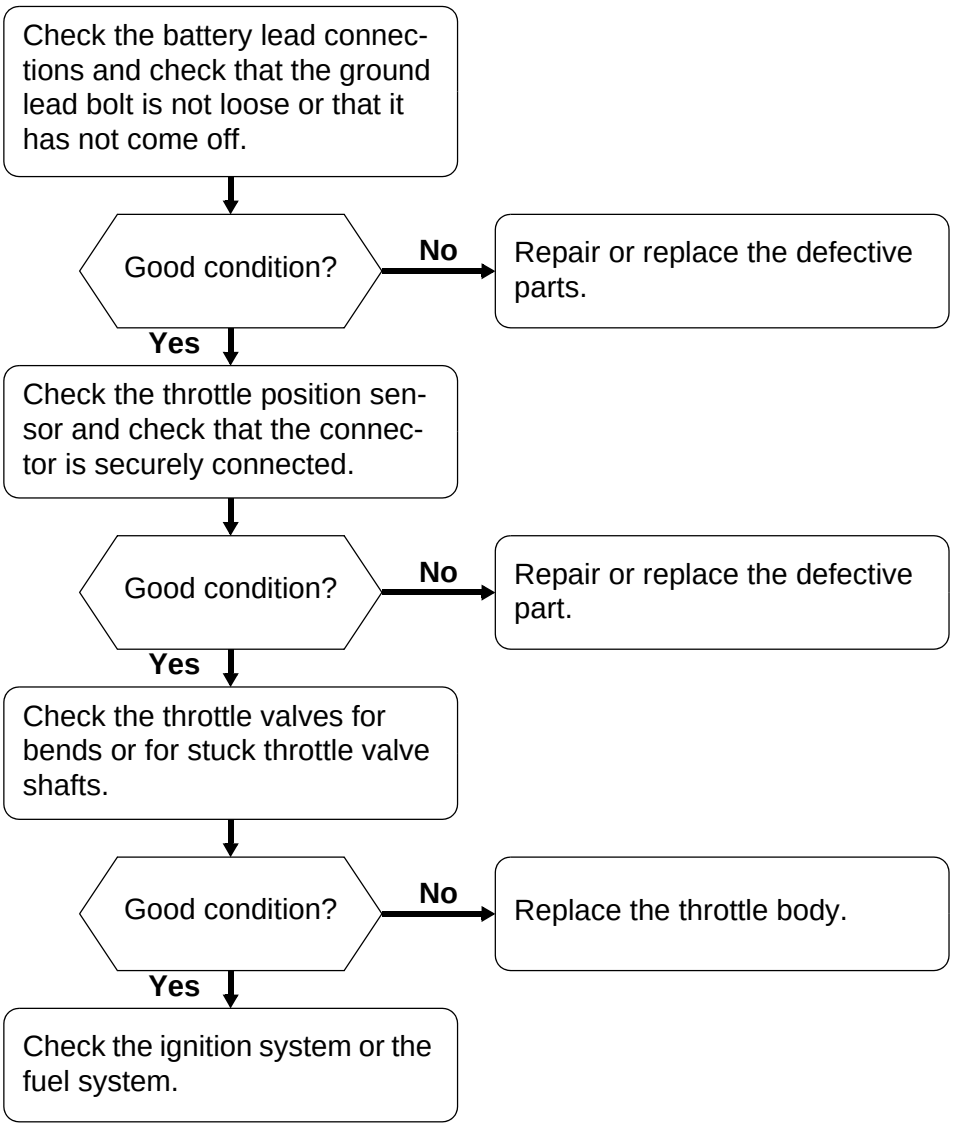
Fuel system


Check the electric fuel pump operation.
Can the operation sound be heard?
No
Check the fuse holder, fuse, and wiring harness for continuity.
Yes
Is there continuity?
No
Repair or replace the defective parts.
Yes
Check the fuel filters for clogs and the hoses for leaks.
Replace the electrical fuel pump.

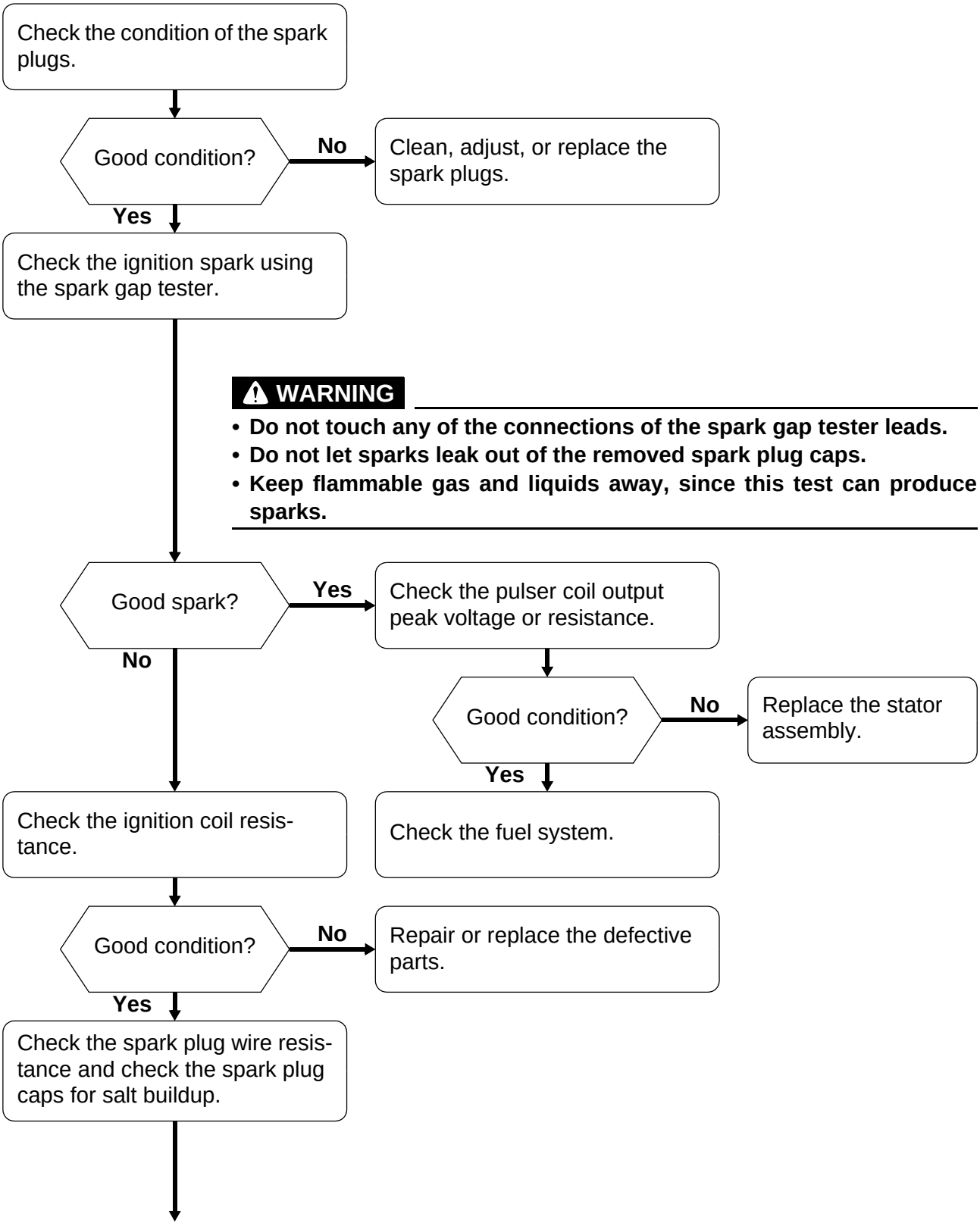
Continued on next page.


Clogs or leaks?
Yes
Repair or replace the defective parts.
No
Check the fuel pump diaphragm.
Cracks or damage?
Yes
Replace the diaphragm.
No
Check the vapor separator needle valve.
Is the needle valve bent or worn?
Yes
Replace the needle valve.
No
Check the injector resistance and check the injectors for clogs.
Good condition?
No
Replace the injectors.
Yes
Check the starting system or the ignition system.

Symptom 2: Engine speed at wide open throttle is low, engine speed decreases, or engine stalls (poor acceleration or poor deceleration).


Check the battery lead connections and check that the ground lead bolt is not loose or that it has not come off.
Good condition?
No
Repair or replace the defective parts.
Yes
Check the throttle position sensor and check that the connector is securely connected.
Good condition?
No
Repair or replace the defective part.
Yes
Check the throttle valves for bends or for stuck throttle valve shafts.
Good condition?
No
Replace the throttle body.
Yes
Check the ignition system or the fuel system.

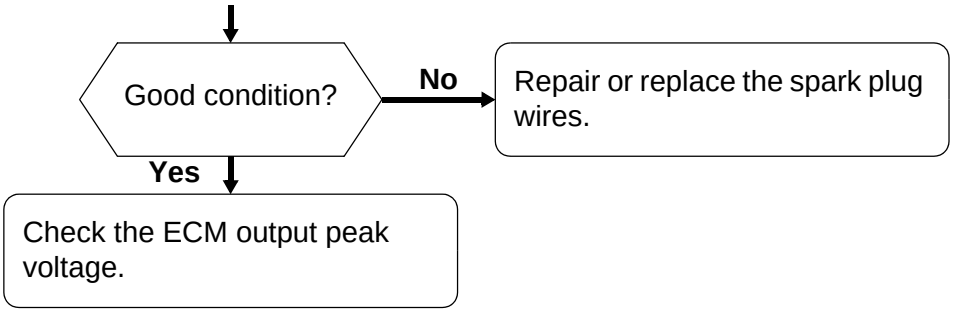
Ignition system



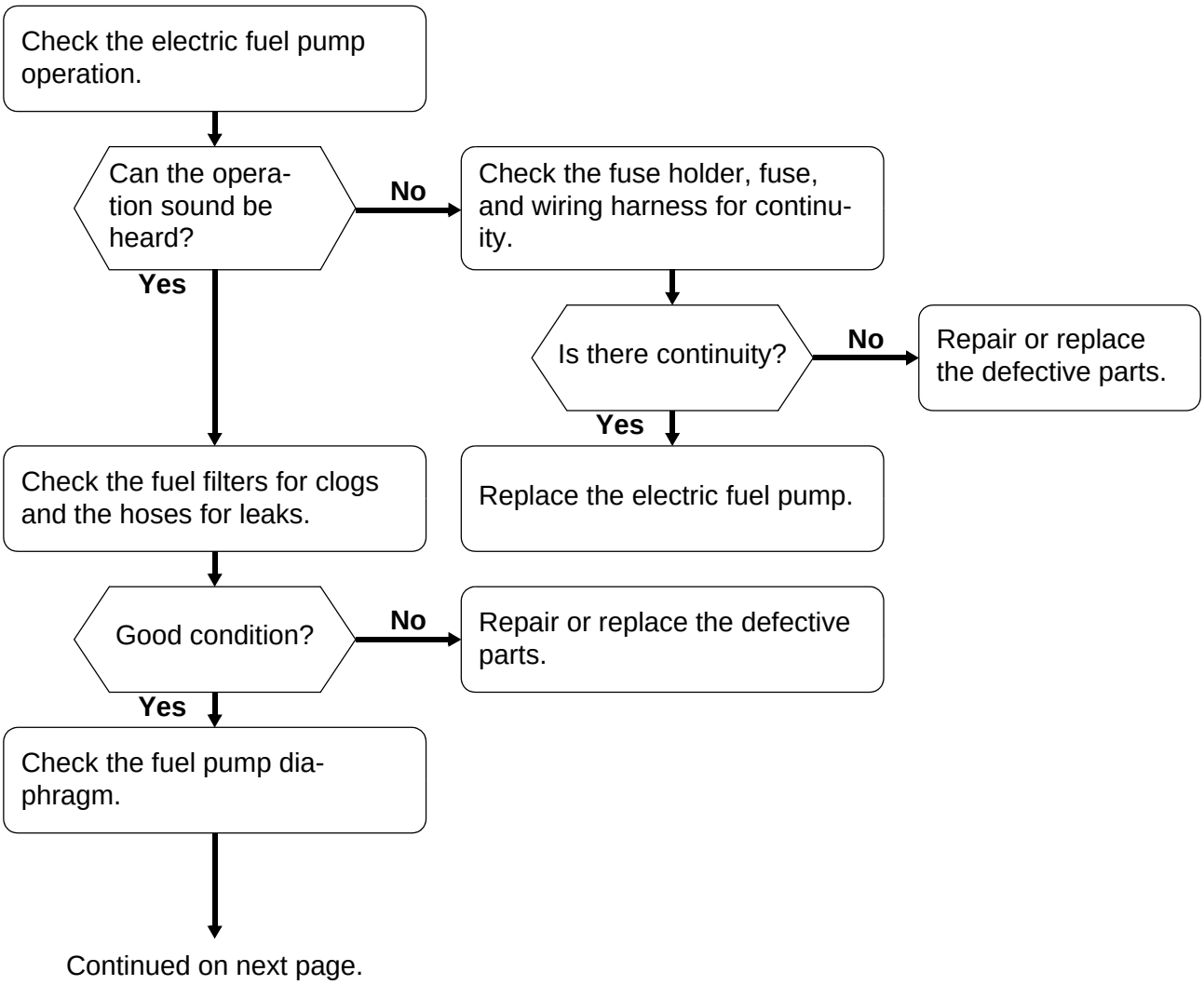
⚠ WARNING

- **Do not touch any of the connections of the spark gap tester leads.**
- **Do not let sparks leak out of the removed spark plug caps.**
- **Keep flammable gas and liquids away, since this test can produce sparks.**

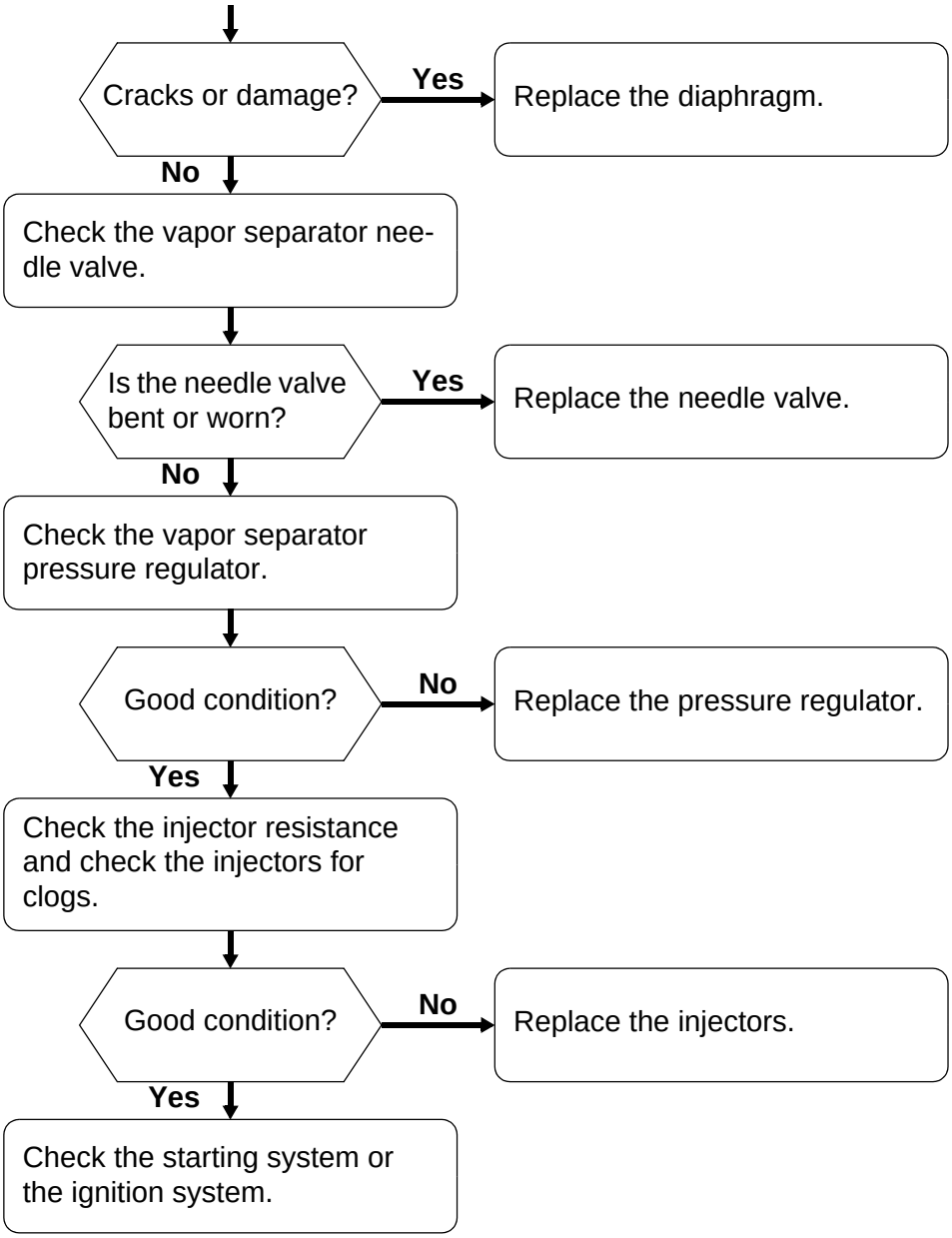
Continued on next page.



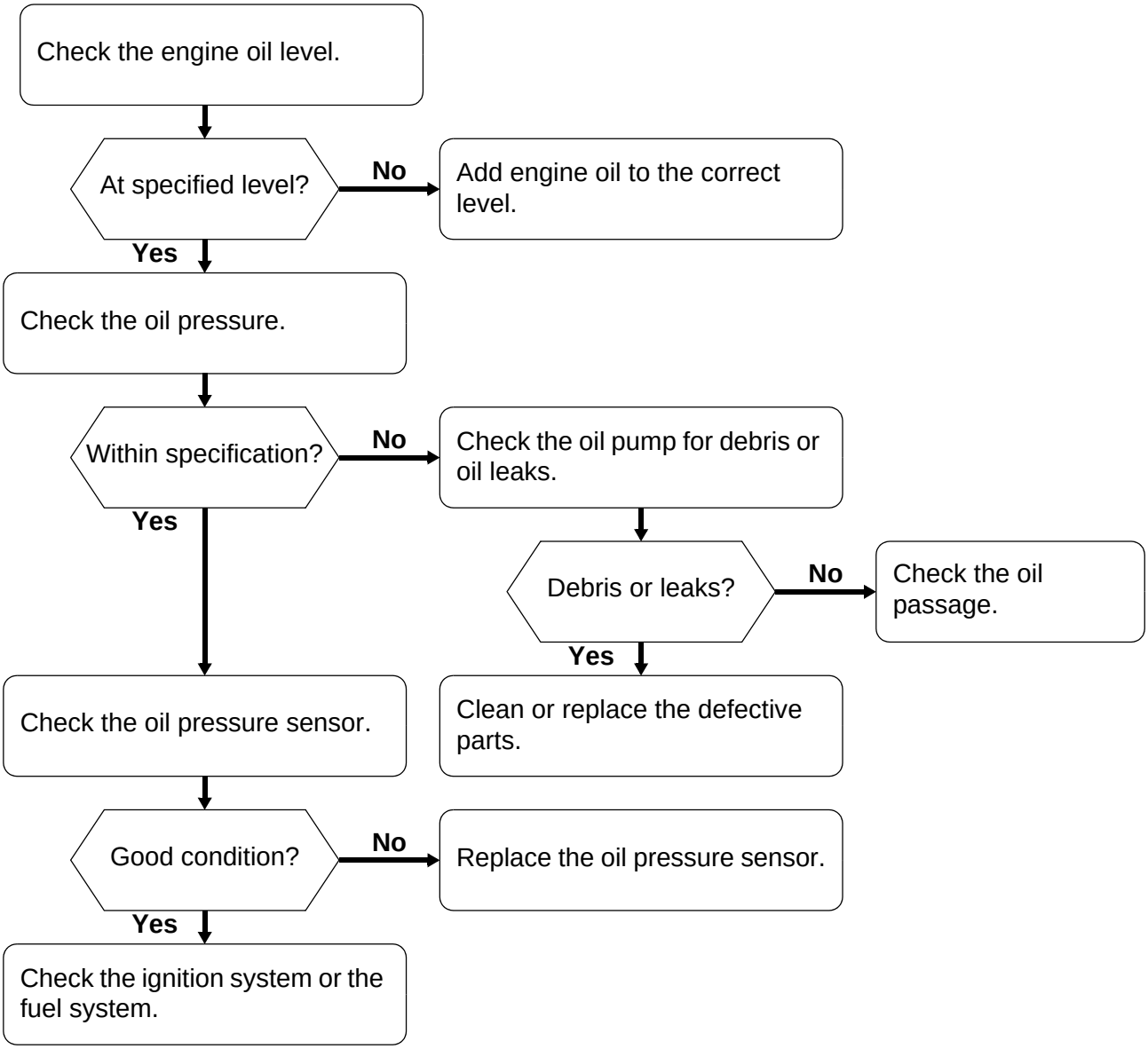
Fuel system


Check the electric fuel pump operation.
Can the operation sound be heard?
No
Check the fuse holder, fuse, and wiring harness for continuity.
Yes
Is there continuity?
No
Repair or replace the defective parts.
Yes
Check the fuel filters for clogs and the hoses for leaks.
Replace the electric fuel pump.
Good condition?
No
Repair or replace the defective parts.
Yes
Check the fuel pump diaphragm.

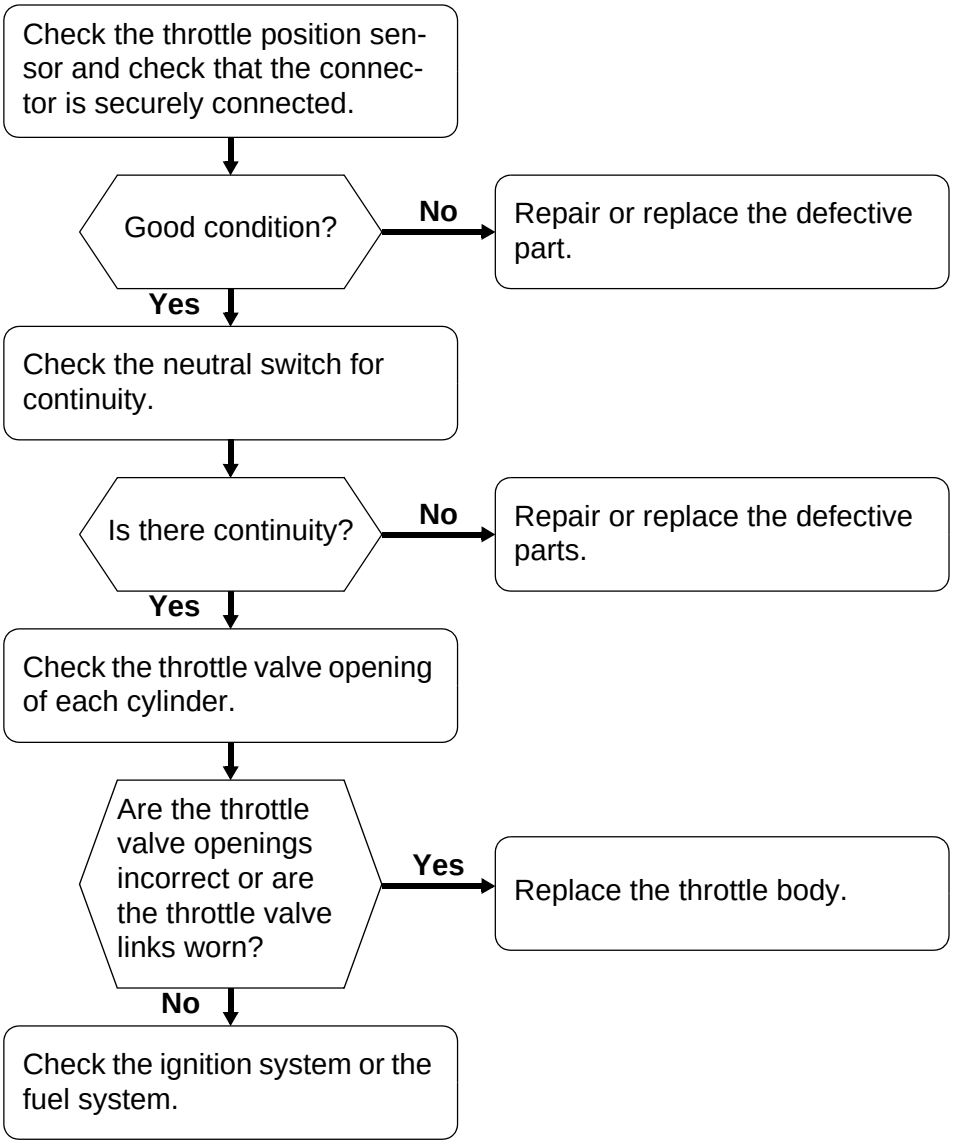
Continued on next page.


Cracks or damage?
Yes
Replace the diaphragm.
No
Check the vapor separator needle valve.
Is the needle valve bent or worn?
Yes
Replace the needle valve.
No
Check the vapor separator pressure regulator.
Good condition?
No
Replace the pressure regulator.
Yes
Check the injector resistance and check the injectors for clogs.
Good condition?
No
Replace the injectors.
Yes
Check the starting system or the ignition system.

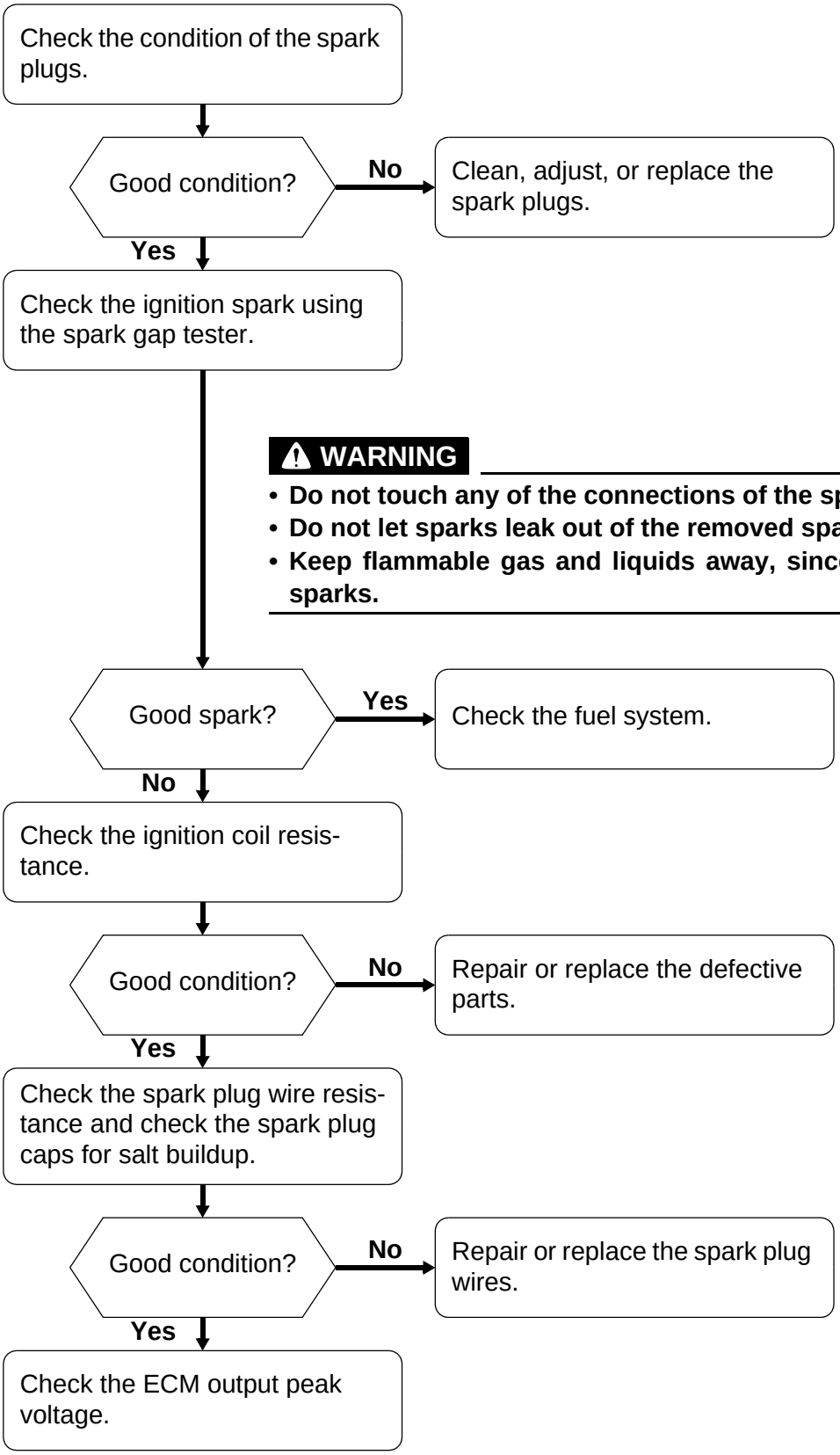
Lubrication system



Symptom 3: Engine speed not stable at low speeds.


Check the throttle position sensor and check that the connector is securely connected.
Good condition?
No
Repair or replace the defective part.
Yes
Check the neutral switch for continuity.
Is there continuity?
No
Repair or replace the defective parts.
Yes
Check the throttle valve opening of each cylinder.
Are the throttle valve openings incorrect or are the throttle valve links worn?
Yes
Replace the throttle body.
No
Check the ignition system or the fuel system.

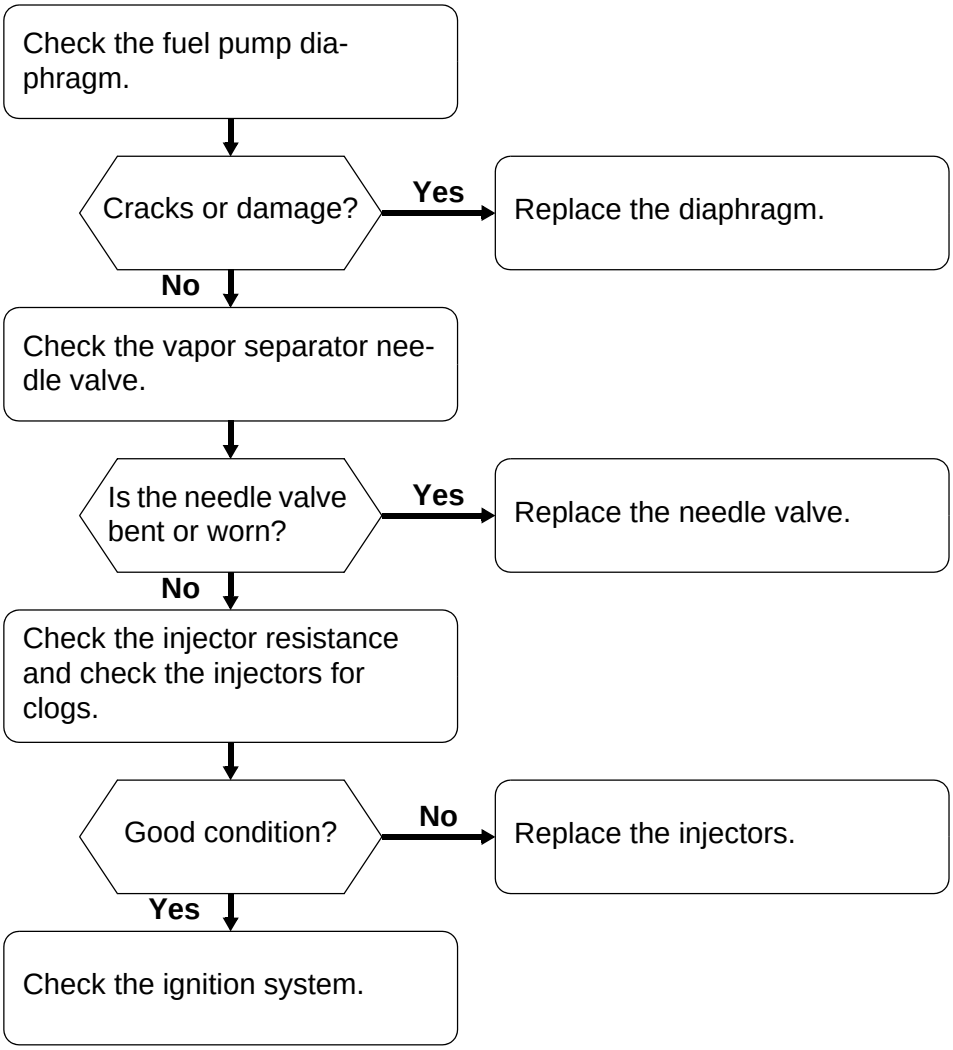
Ignition system



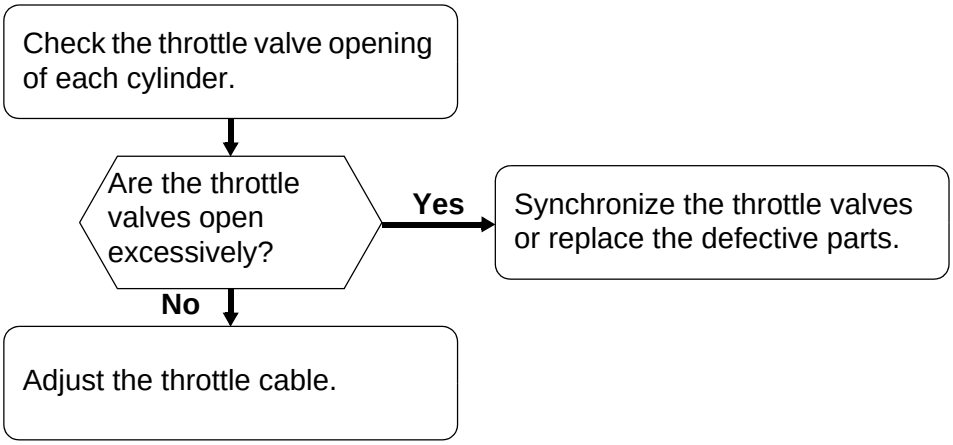
⚠ WARNING

- **Do not touch any of the connections of the spark gap tester leads.**
- **Do not let sparks leak out of the removed spark plug caps.**
- **Keep flammable gas and liquids away, since this test can produce sparks.**

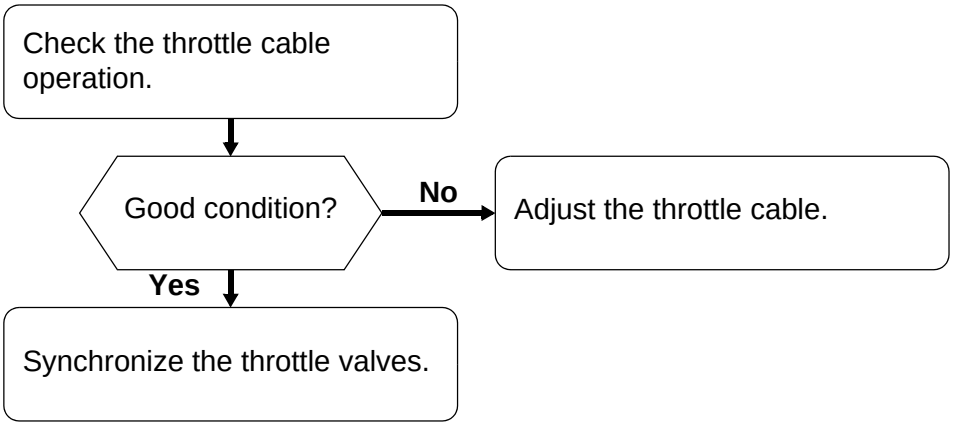
Fuel system


Check the fuel pump diaphragm.
Cracks or damage?
Yes
Replace the diaphragm.
No
Check the vapor separator needle valve.
Is the needle valve bent or worn?
Yes
Replace the needle valve.
No
Check the injector resistance and check the injectors for clogs.
Good condition?
No
Replace the injectors.
Yes
Check the ignition system.

Symptom 4: Hunting occurs.


Check the throttle valve opening of each cylinder.
Are the throttle valves open excessively?
Yes
Synchronize the throttle valves or replace the defective parts.
No
Adjust the throttle cable.

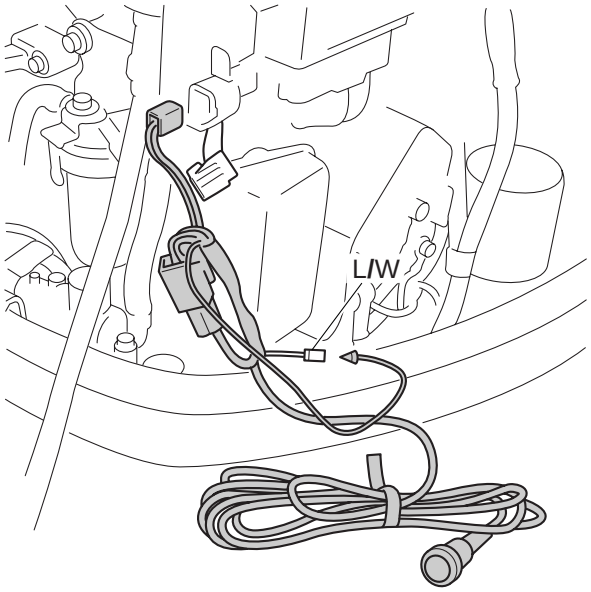
Symptom 5: Engine speed rises even when the throttle position is fixed.



Self-diagnosis

Diagnosing the electronic control system

1. Connect the special service tool to the outboard motor as shown.



S63P9010

NOTE:
When performing this diagnosis, all of the electrical wires must be properly connected.

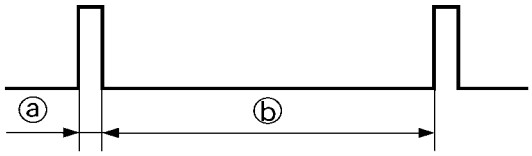
Diagnostic flash indicator B:
90890-06865

2. Start the engine and let it idle.

3. Check the flash pattern of the diagnostic flash indicator to determine if there are any malfunctions.

   - Normal condition
     (no defective part or irregular processing is found)

   - Single flash is given every 4.95 seconds.
     ⓐ: Light on, 0.33 second
     ⓑ: Light off, 4.95 seconds



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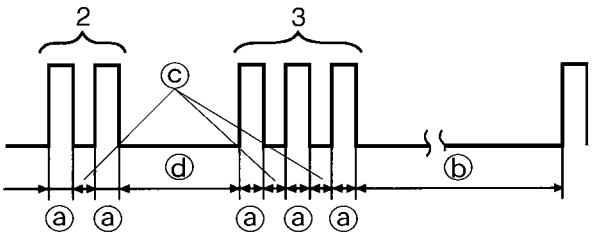
   - Trouble code indication
     Example: The illustration indicates code number 23.
     ⓐ: Light on, 0.33 second
     ⓑ: Light off, 4.95 seconds
     ⓒ: Light off, 0.33 second
     ⓓ: Light off, 1.65 seconds



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4. If a flash pattern listed in the diagnostic code chart is displayed, check the malfunctioning part according to the flash pattern.

NOTE:
When more than one problem is detected, the light of the diagnostic flash indicator flashes in the pattern of the lowest numbered problem. After that problem is corrected, the light flashes in the pattern of the next lowest numbered problem. This continues until all of the problems are detected and corrected.

Code	Symptom
1	Normal
13	Incorrect pulser coil signal
15	Incorrect engine temperature sensor signal
18	Incorrect throttle position sensor signal
19	Incorrect battery voltage
23	Incorrect intake air temperature sensor signal
28	Incorrect neutral switch signal
29	Incorrect intake air pressure sensor signal
37	Incorrect idle speed control signal
39	Incorrect oil pressure sensor signal
44	Incorrect engine stop lanyard switch signal
45	Incorrect shift cut switch signal
46	Incorrect thermoswitch signal

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Killer Whale 150

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② Ignition coil
③ Thermoswitch
④ Oil pressure sensor
⑤ Diode
⑥ Starter relay
⑦ Starter motor
⑧ Starting battery
⑨ Accessory battery
⑩ Fuse holder
⑪ Fuse (30 A)
⑫ Fuse (20 A)
⑬ Fuse (50 A)
⑭ Intake air temperature sensor
⑮ Power trim and tilt relay
⑯ Power trim and tilt motor
⑰ ECM
⑱ Pulser coil
⑲ Stator coil
⑳ Engine temperature sensor
㉑ Rectifier Regulator
㉒ Power trim and tilt switch
㉓ Trim sensor
㉔ Idle speed control
㉕ Throttle position sensor
㉖ Intake air pressure sensor
㉗ Fuel injector
㉘ Electric fuel pump
㉙ Shift cut switch
㉚ Neutral switch
㉛ Main relay

Ⓐ To personal computer for diagnosis
Ⓑ To remote control box/switch panel
Ⓒ To trim meter
Ⓓ To warning indicator
Ⓔ To diagnostic flash indicator
(special service tool)

(*1) Isolator cable (optional)
(*2) Negative cable (commercially available)

Color code

B	: Black
Br	: Brown
G	: Green
Gy	: Gray
L	: Blue
Lg	: Light green
O	: Orange
P	: Pink
R	: Red
Sb	: Sky blue
W	: White
Y	: Yellow
B/O	: Black/orange
B/W	: Black/white
B/Y	: Black/yellow
Br/W	: Brown/white
G/B	: Green/black
G/R	: Green/red
G/Y	: Green/yellow
L/G	: Blue/green
L/W	: Blue/white
L/Y	: Blue/yellow
P/B	: Pink/black
P/G	: Pink/green
P/W	: Pink/white
Pu/B	: Purple/black
Pu/G	: Purple/green
Pu/R	: Purple/red
Pu/Y	: Purple/yellow
R/Y	: Red/yellow
W/B	: White/black
W/R	: White/red
Y/G	: Yellow/green

Killer Whale 150

1	2	3	4			7	8	9	10
G	Y/G	P	W			B/Y	B	L/Y	O
	12		14	15		17	18	19	20
	O		W/R	W/B		L	G/B	G	G/R
21	22	23	24		26	27	28	29	30
G/Y	B/O	P/B	P/W		W/B	L/W	Y	P/W	R/Y
31	32	33	34	35		37	38	39	40
L/G	B	P/G	P	B/Y		P	Pu/Y	Pu/B	Pu/R
	42	43	44						
	B	Pu/G	B/W						

1	2	3	4	5	6	7	8	9	10
Y/G	R	R	R	R/Y	R/Y	R/Y	R/Y	R/Y	R/Y
11	12	13	14	15	16	17	18	19	
R/Y	R/Y	R/Y	R/Y	R	R	R	R	R	

	Sb	R	Lg
UP	○		○
FREE			
DOWN	○		○

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